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PC MAGAZINE

Our 350th Issue

Exclusive: The PC Magazine 100 Most Influential Companies

- **Shareware: 60 Programs Rise To the Top in Our Annual Contest**
- **Professional Graphics: We Test 10 Top Packages**
- **The Best CPU For You: Our Tech Overview Will Help You Choose**
- **First Looks: 5 Bright Digital LCD Monitors**
- **Net Tools: 8 10/100 Server Adapters**



WWW.PCMAG.COM THE INDEPENDENT GUIDE TO PERSONAL COMPUTING VOL. 17 NO. 16 SEPTEMBER 22, 1998

100 companies that are changing the way you compute

Who's Rising, Falling, And Up and Coming

MICROSOFT INTEL IBM COMPAQ HP CISCO SUN AOL DELL NETSCAPE ORACLE 3COM YAHOO! GATEWAY ADOBE APPLE NOVELL TOSHIBA MACROMEDIA INTUIT NEC/PACKARD BELL SOFTBANK/ZIFF-DAVIS CANON REALNETWORKS SONY BAY NETWORKS COREL SYMANTEC SILICON GRAPHICS SEIKO EPSON LUCENT SEAGATE AMAZON.COM NETWORK ASSOCIATES MICRON AUTODESK CREATIVE TECHNOLOGY GT INTERACTIVE ASCEND COMPUTER ASSOCIATES ADVANCED MICRO DEVICES CENDANT ADAPTEC NATIONAL SEMICONDUCTOR AT&T TEXAS INSTRUMENTS INTERNATIONAL DATA GROUP ACER XEROX NVIDIA IOMEGA RAMBUS ATI MATSUSHITA DIAMOND DIALOGIC S3 METACREATIONS WESTERN DIGITAL MATROX SHARP FUJITSU HITACHI VIEWSONIC SYBASE MCI MOTOROLA 3DFX LOGITECH INPRISE BRODERBUND POINTCAST GARTNER GROUP CABLETRON SYSTEMS PC CONNECTION ACTIVISION CIRRUS ASYMETRIX QUARTERDECK PHILIPS INFORMIX QUANTUM VOCALTEC LEXMARK SAP SAMSUNG /AST PHOENIX DRAGON SYSTEMS NUMBER NINE EASTMAN KODAK DELORME MAPPING QUARK CIDCO PEOPLESOFT THE SANTA CRUZ OPERATION ROCKWELL @HOME IN FOCUS THE LEARNING COMPANY CDW

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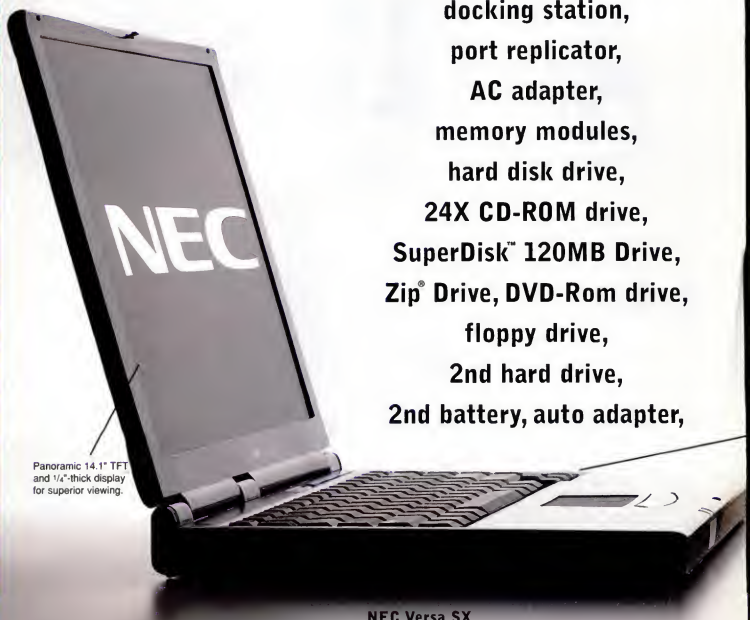
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- 64MB 100MHz SDRAM
- 8.4GB Ultra ATA hard drive
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- New MicroTower Case
- 82440BX chip set
- 512KB internal cache, 2MB Flash BIOS
- 3.5" floppy drive
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PC Magazine Editors' Choice, August 1998 Blockbuster Issue.

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Built for Speed



Today's computers are fast enough. That's the message you hear from my colleagues in the press, proponents of stripped-down computers, and corporate IT departments. Their reasoning is simple: The most important uses of computers are office productivity applications and Internet access. Corel WordPerfect, Lotus SmartSuite, and Microsoft Office all run just fine on a Pentium/200. Internet speed is held back more by modems than by computers. Therefore, we don't need to have computers become any faster. It's a seductive argument, but I disagree with it.

In reality, today's computers aren't nearly good enough for what we want to do with them. As we pointed out in our July issue on service and reliability, readers reported that one of every three machines they had used during the past year had a service or support issue. In many cases, the problem isn't physical reliability but that it's just too hard to operate the products properly.

We need computer and software vendors to focus on reliability and ease of use. But that doesn't obviate speed. Today's PCs are nowhere near fast enough for the kinds of applications that I expect to see in the next few years.

What kinds of applications need more processing power? Games, for one. Game designers have already proved they can take advantage of every increase in processing speed, in 3-D rendering, and in improved audio. With more speed, you'll see better movement of characters and better modeling of 3-D worlds. You'll get more realistic sound and video, too, particularly when speed is coupled with DVD drives.

Other kinds of entertainment are also crying out for more power. You'll see "multipath" movies, in which you can choose the ending. You'll see more interactive online environments, with people communicating with one another via virtual characters. The combination of DVD, the Web, and fast PCs will change the way we look at movies and TV.

Each new version of an operating system or office suite seems to require a newer system to work optimally. I know people who have spreadsheets that still take hours or days to recalculate, even on the fastest of today's PCs. Some people want to add even more complex calculations, such as neural networks and genetic algorithms.

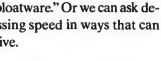
Desktop videoconferencing is close to becoming a mainstream application. Biometric methods—such as fingerprint recognition, face recognition, and voice matching—may well replace traditional passwords. Automatic language translation is improving.

The current crop of speech recognition products promise that you'll be able to dictate to your computer. Although they're not yet perfect, with additional processing power they'll be able to evaluate more alternatives quickly and integrate speech recognition with more sophisticated grammar and language engines. Add natural-language processing—another huge consumer of processing power—to speech recognition and you may get an entirely new user interface.

Developers are also talking about systems that determine what you want to do on your PC by the movement of your head or body or by the tracking of your eyes. Virtual-reality and 3-D effects may well become part of the standard UI. And I'm looking forward to agents that search more intelligently through information on my local machine, my network, and the Web even when I'm not at my computer.

You'll need even more power if you combine all these things into an application that uses them simultaneously. Perhaps we'll have personalized characters that can interact with us in a much more realistic way and can do lots of work for us.

It won't happen overnight, but this isn't science fiction. All the things I'm talking about are projects that some developers or research labs are working on today. We can complain about "bloatware." Or we can ask developers to utilize processing speed in ways that can make us all more productive.



MICHAEL J. MILLER

PHOTOGRAPH BY BRENDA VALESKA

INTRODUCING A WHOLE NEW

The Sun™ Ultra™ 5 and Ultra 10 workstations. They're an evolutionary leap over all lower forms of workstations. Because they're full-fledged Sun workstations (with up to a 300MHz processor, no less) that'll run all your favorite PC apps* while delivering the power, scalability, networkability, and robust UltraSPARC™/Solaris™ performance you've come to expect from Sun. And all starting at $2,395.** (Roughly 30% less than a comparably equipped Compaq system!) With these workstations, you can run heavy-duty applications one moment, then craft presentations using Microsoft Office the next.* What's more, the Ultra 10 with its Elite3D graphics blows away a similar SGI machine. And at less than *a quarter* of the cost!† And since both Sun models are binary compatible, they'll run over 12,000 applications available for Sun. (And now every PC application beneath it.) All of which just may make them the missing links you've been looking for. For more information, call 800-SUN-FIND for a Sun reseller or representative near you. Or visit our Web site at sun.com/ult. THE NETWORK IS THE COMPUTER.™



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COVER STORY

100 MOST INFLUENTIAL COMPANIES PC Magazine



Fascinating as this industry is in most every aspect, few things intrigue us more than watching the continual ebb and flow as the fortunes of computer companies shift ceaselessly in the face of many uncontrollable factors—and maybe a few that are controllable. Influence, says *PC Magazine* editor Jake Kirchner, is as fleeting as fame. This year, in addition to our list, we spotlight four particularly intriguing first-time members of the list and their CEOs..... **100**

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The Best CPU for You

BY MICHAEL SLATER

Though Intel still controls a majority share of the microprocessor market, its competitors—AMD, Cyrix, and newcomer IDT—are providing chips for an admirable number of today's midrange and low-end systems. To help you choose the right chip for your particular needs, we thoroughly test a wide range of CPUs and compare their strengths and weaknesses.....133

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The 1998 PC Magazine Shareware Awards

BY SHERYL CANTER

Have we got some nifty programs for you! For the fifth annual Ziff-Davis Shareware Awards, editors from ZDNet sifted through some 14,000 entries. We identified 114 finalists in 23 categories sent for judging to three Ziff-Davis magazines. Here *PC Magazine* presents the winners in its 12 categories.....231

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SOFTWARE

Professional Graphics

BY SALLY WIENER GROTTA AND DANIEL GROTTA

Few market areas have felt the heat of the Web as keenly as graphics software. Now called on to create projects for all kinds of media, these image-editing and illustration packages are more versatile and sophisticated. For professional designers and artists, it's all good news on the PC 150

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What's one of the hottest, yet most underrated, Web applications with the highest payoff? Tech support. More and more companies are turning to the Web to make their tech-support operations more efficient and to help customers escape the tyranny of the telephone—phone tag, busy signals, and elevator music.

Drawing on "deep computing" concepts, which use complex statistical analysis to reveal interesting characteristics about data, IBM has created a vast digital warehouse of tech-support know-how called Knowledge Base. Initially conceived with the help of scientists at IBM's T.J. Watson Research Lab, Knowledge Base until recently has been available only to IBM technical-support staff. Now, IBM customers can access Knowledge Base over the Web to solve hardware problems for themselves.

After taking on an online profile of your system during registration, Knowledge Base asks you questions about the symptoms and is able to diagnose digital ailments and suggest remedies. Next year, IBM plans to automate the system further to dispatch software agents for repairs.

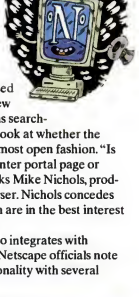
Intel recently launched AnswerExpress, a Web-based service covering hundreds of applications that takes snapshots of your system's vitals to give live support technicians a running start. Once a technician receives an inquiry over the Web, you'll get a call back within 10 minutes.

And newcomer Motive Communications remotely harvests system information, makes diagnoses, and repairs problems over the Web. Motive's mission? To cut $25 billion of waste out of tech-support services by 2005.

The XXX Files

55% of respondents to a recent PC Magazine Online poll told us they thought that pornography should continue to be allowed on the Web without restriction. 26 percent said that online porn should be regulated, while 19 percent said that it should be banned outright.

Eye-Catching Browsers



As Netscape rolls out Communicator 4.5, a primary goal is to get Communicator's features to orbit around core features in Netscape's Netcenter 2.0 portal page. The focus on Netcenter integration illustrates the critical role browsers are playing in attracting valuable traffic to portal pages.

At Netscape's recent Strategy Day in San Francisco, CEO Jim Barksdale said that Netscape was moving aggressively toward electronic commerce, with the Netcenter portal page leading the charge.

Officials at Microsoft, though, have stressed that as Netscape directs Communicator's new features toward greater functionality, such as searching at its own portal page, it's important to look at whether the new features are being implemented in the most open fashion. "Is their primary focus getting hits to the Netcenter portal page or getting the right functionality for users?" asks Mike Nichols, product manager for the Internet Explorer browser. Nichols concedes that features such as easier URL integration are in the best interest of consumers.

Microsoft's Internet Explorer browser also integrates with Microsoft's own Web pages in several ways. Netscape officials note that the Netcenter page integrates its functionality with several other search engines.

The Sheepdog Interface



According to Dr. Nathan Myhrvold, chief technology officer at Microsoft: "A lot of people have unrealistic goals for artificial intelligence. A computer doesn't have the qualities of a good secretary, who knows how to handle exceptions and has common sense and perseverance. Those are the last things computers will have.

"Here's an analogy. If you want to herd sheep, you should use a sheepdog. You shouldn't use a human trained in herding. The dog may not be smart, but it has a specialized skill and understands the problem. It has a voice interface (the bark), and sheep are afraid of it. We just need to get Windows and the browser to be as smart as the dog. They don't have to be as smart as a human."

ILLUSTRATIONS BY ROBERT NEUBECKER (TOP), RICHARD LLEWELLYN (BOTTOM), PAUL CORIO (RIGHT)

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The 100 Most Influential Companies	This issue's cover story focuses on the most influential companies in computing. Download the data files we used to rank them.
PC Tech's Top Ten Downloads	We keep a running tally of our most popular downloads. Get the free utilities everyone's talking about.
Have a Laugh With ARF Online	Yes, computing can be funny, and we're proving it with Abort, Retry, Fail? Stop by for a few chuckles.
Second Looks: Your Opinion Counts	You've used the products, now tell us what you really think. We ask for your opinions every Friday.
Make Yourself Heard In Our Poll	Stop by every Thursday afternoon or Friday morning to participate in our weekly online poll. Get the results online and in the Trends section.

Pipeline

A Fountain of Youth for Old PCs

Got some old PCs running DOS or Windows 3.1? If so, Sun Microsystems wants to turn them into Java-based network computers. The company has delivered its $99 JavaPC Engine 1.0 software, which is targeted at legacy hardware. The hope is to proliferate Java as a platform within enterprises, though users of JavaPC Engine will still be able to run Windows and DOS.



Some industry analysts have pronounced the network computer concept—stripped-down hardware platforms designed to run Java applications—dead. Even Oracle chief Larry Ellison has turned down the volume on his support for the devices.

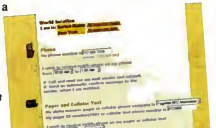
But Sun executives still maintain that low-end hardware systems are prime platforms for Java. Many enterprises have chosen to eschew network computers, but there's no shortage of 486-, 386-, and 286-based computers in enterprises.

Because of storage and memory constraints, many of these systems run older versions of DOS and Windows. With Sun's new software, companies can deploy applications compliant with the Java Development Kit 1.1 in network environments without disturbing DOS and Windows applications. JavaPC Engine is based on a unique Java Virtual Machine and includes an application launcher, class libraries, and automated installation.

Notably, though, the first version of JavaPC Engine doesn't include Internet-browsing capabilities of any kind.

E-Mail That Chases You Down

As you're racing through the airport to catch a connection, an important client is sending you an urgent e-mail and your boss has just fired off an e-mail with financial data that you'll need to review on the flight. There's no time to find a phone line to download the messages. It's either time for a vacation or time to set up a M@ilPush account.



Redirect: *M@ilPush delivers your e-mail to your cell phone, fax, or pager.*

New E-mail Communications Systems *(www.mailpush.com)*, a startup based in Herzliya, Israel (and a Bell-South subsidiary) recently launched a $4.99-per-month service that grabs your e-mail from your PC and reroutes messages to your pager, cell phone, or fax. A central "grabber" server located in Israel checks up to a million subscriber mailboxes every 5 to 7 minutes for new e-mail and notifies subscribers in several ways: You can have the entire message read to you over the phone via text-to-speech technology, have it faxed to you, or have the subject and sender information dispatched to your pager. M@ilPush currently offers coverage in Israel and the U.S.; Brazil, Chile, Columbia, Japan, Peru, Switzerland, and Venezuela are next in line.



Peek at Your Own Peril

Should law enforcement officials have access on demand to networked data everywhere? That question has brought about an international stalemate on how to actualize a global data-encryption plan.

High-tech companies in the U.S. want to implement global standards for encrypting (scrambling) data so that they could export their products to other countries. But many countries object to proposed key-recovery plans, which provide law enforcement officials up-front access to keys for unscrambling encrypted data.

Now 13 U.S. companies are backing a proposal designed to make countries around the globe encryption-friendly by putting an intermediary in front of law enforcement officials. Specifically, under the "private doorbell" proposal, law enforcement officials would need a court order to get encrypted data from a network manager.

"Relief from export controls is an industry-wide matter," says Netscape CEO Jim Barksdale. "We believe the private-doorbell feature, if successful, will demonstrate that industry and government can work together."

Top-Selling Retail Notebooks

1. IBM ThinkPad 600 PP266 ($3,528)
2. IBM ThinkPad 770 M233 ($3,206)
3. IBM ThinkPad 380XC M233 ($2,136)
4. IBM ThinkPad 380ED M166 ($1,754)
5. Toshiba Tecra 550CDT ($3,604)
6. IBM ThinkPad 600 PP233 ($3,219)
7. Compaq Armada 1582DMT M166 ($2,474)
8. Toshiba Satellite 325CDS M233 ($1,780)
9. Toshiba Satellite 325CDS M266 ($2,128)
10. IBM ThinkPad 380XD M266 ($2,631)

Source: ZD Market Intelligence. Data for July 1998.

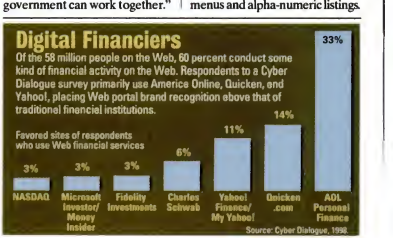
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Digital Financiers

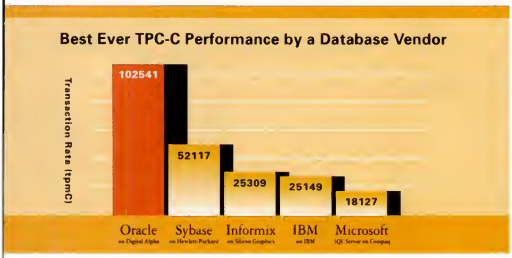
Of the 58 million people on the Web, 60 percent conduct some kind of financial activity on the Web. Respondents to a Cyber Dialogue survey primarily use America Online, Quicken, and Yahoo!, placing Web portal brand recognition above that of traditional financial institutions.



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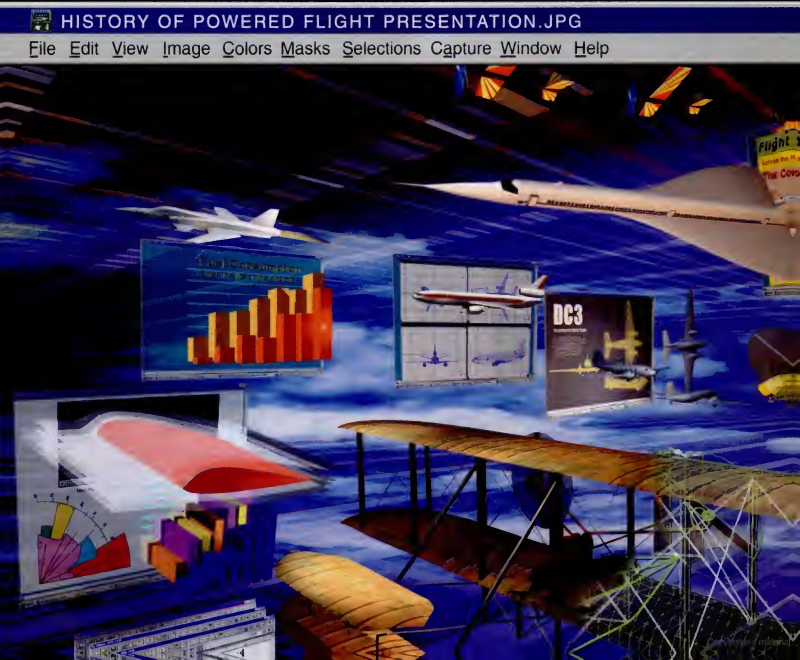


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Letters

PC PERFECTIONISTS

Your July 1998 cover story is misleading: "The Perfect PC" is totally unattainable as long as humans are manufacturing the equipment. The perfect PC would not lock up, would install software perfectly the first time, and would recognize new hardware right away. It would not need to be updated; the speed would be instantaneous, and the monitor would not harm us. The perfect PC would not cost a penny and would never wear out, break, or crash. Until hardware makers and software developers coordinate their efforts to resolve conflicts that irritate users, I think we are a long way off from the "Perfect PC."

JEFF PETERSON
via the Internet

I'm a 17-year-old who reads *PC Magazine* whenever my dad brings an issue home. In your July issue you describe a dream PC, but you don't mention accessories, most notably gaming devices. A system with the power of your "centerfold" PC should at least have a force-feedback joystick, a game pad or two, probably a throttle stick for good measure, and maybe even a steering wheel. With that power, a gamer could run virtually anything at any setting. Speaking as a gamer running some of the greatest games ever on a system that belongs a few years in the past, I suggest you cover all the bases on your dream PCs.

CHARLES ENDERLIN, JR.
Little Rock, Arkansas

You really had me hooked. I purchased this issue hoping you would say which computer was the best and tell me what to buy. Instead, all I got was the same old stuff. You really missed your chance to provide your expert opinion to the consumer. You could have discussed the merits of each PC: Selecting functionality is the easy part, but deciding which PC to buy is the real trick. Consumers want you to rate PCs for performance, reliability, ease of upgrading, support, and cost. Instead, you told us what we already know. The story sure didn't live up to its title. There is not even a clue as to which is the best PC.

FRED ELKINS
Liverpool, New York

The intent of the Perfect PC issue was to provide a reference guide to the features and components you should look for when purchasing a PC, a notebook, a peripheral, or network hardware. If you're looking for reviews based on testing in PC Labs, check out just about any of our other issues, in which we test and review hundreds of products and make product recommendations.—Ed.



Perhaps "State-of-the-Art PCs" would be a more appropriate title.

RAPID OBSOLESCENCE

Today's latest and greatest equipment is frequently superceded by better and less expensive equipment after only a few months. Within a year, the best becomes average, and after about three years it becomes obsolete. In view of such rapidly evolving technology, the concept of a "Perfect PC" is strange, especially considering the sophistication and wisdom of your senior editorial staff. The concept appears to be a marketing ploy designed to fool newer readers into believing that now is the time or soon will be the time to purchase the perfect PC. I think it's time to deal with the issue more honestly and put the interests of the readers ahead of the vendors. Perhaps "State-of-the-Art PCs" would be a more appropriate title than "Perfect PCs."

ARTHUR COHEN
Rockville, Maryland

RATING THE RATINGS

I'd like to comment on WinBook's scores in your Service and Reliability Survey ("Desktops and Notebooks," July 1998). These are areas we have also been very concerned with, and we have made numerous changes to improve reliability for our customers. A year ago, WinBook was selling products from four different manufacturing partners. Not only did reliability vary among partners, but trying to work with four partners made it more difficult for us to control reliability, since our focus was divided among the four companies. Last September, we standardized on one manufacturing partner with superior reliability—Twinhead—for all WinBook production. The WinBook XL and XLi models produced today offer our customers the best reliability in our history, with the fewest warranty claims and customer-service calls per unit. Combined customer-service and technical-support calls per unit, to date in 1998, are down 20 percent from last year. It is regrettable that *PC Magazine* readers, based on data collected primarily on discontinued products from manufacturers we no longer use, will erroneously conclude that the WinBook XL and XLi are among the most unreliable notebooks on the market. In fact, our own data shows that they are the most reliable products we have ever offered. In addition to improving reliability, within the past year WinBook has cut the average customer-service hold time by 60 percent.

ED LUKENS
Marketing Manager, WinBook

I've looked over your report every year, and it provides some useful information. This year I read it with closer attention to the methodology, and I have some concerns. Though you report the number of responses, why isn't this value a data point? This speaks to the issue of what your subscribers buy, possibly more important than any of the ratings. Also, if you know the base rate of national sales for each of the systems, you can compare it with your subscribers' buying habits, which I would assume reflect the actions of a more knowledgeable group. Second, your repair figures and ratings are confounded by the fact that you do not assess the age of the systems. Company A's repair frequency may be higher than B's because people like A's systems so much that they keep them around longer. This information should at least be reported; using system age as a statistical covariant would be a sound option. Finally, you should differentiate between major and minor repairs. It's one thing if your floppy disk drive dies; it's quite another if you have motherboard problems.

THOMAS J. PAYNE
via the Internet

PROCESSOR ALTERNATIVES

Disappointingly, neither "Processors" ("The Perfect PC," July) nor "The State of Processors" (PC Tech/Tutor, July) makes any mention of IDT's C6 processor. The C6 has a simplified architecture; this results in a smaller die size, which is cheaper to manufacture, uses less power, runs cooler, and should be more reliable than the AMD, Cyrix, and Intel processors that are included in the articles. Yet mention *was* made of the PowerPC, which has been on the market for years and is rapidly going nowhere.

JOHN TATE
via the Internet

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— Assistant Director, Technical Support, Stephen F. Austin State University

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Letters

Thank you for your coverage of Motorola and PowerPC processors in your PC Tech/Tutor section. It's good to see that *PC Magazine* is interested in computer solutions offered by companies other than Intel.

BRIAN CONLEY
via the Internet

Your PC Tech article seems focused on the theory that faster equals better, which is not necessarily true. I'm sure other articles will cover this, but I thought I'd point out the important issue of ease of use. Without a doubt, the Macintosh offers the easiest-to-use desktop OS. This means Mac users are typically more productive than Wintel users, leading to a better ROI (return on investment) and lower TCO (total cost of ownership) in computing hardware and peripherals. And when you consider Microsoft's impending downfall in the light of DOJ proceedings coupled with Intel's lagging position in the CISC-versus-RISC race, the Mac platform seems more attractive.

JONATHAN MAO
New South Wales, Australia

STAND BY YOUR REVIEW

The review of the ELSA GLoria-XL in "High-End Graphics Cards" (June 30) misrepresented the product and the solutions it offers. The review failed to mention several application-specific drivers and viewers ELSA offers for market-leading applications such as AutoCAD and 3D Studio MAX, as well as the card's stereo output and multiscreen capability. The primary performance tests used for MCAD testing were Indy3D and Pro/Engineer. A more balanced review would have also tested AutoCAD performance.

THOMAS NEUBERT
VP Sales & Marketing, ELSA Inc.

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Corrections and Amplifications

In the August Trends/Software story "The Best of Both Worlds," V Communications' phone number should be 800-648-8266.

In the May 26 article "Personal ISDN Routers," we incorrectly said that the ZyXEL Prestige 100 and Prestige 128 do not contain DHCP or DNS capabilities. These capabilities are available via the command line interface. They just didn't work through the beta version of their Java applet-based Web Configurator; in the same story, the Summary of Features table reported that the Shiva AccessPort 2.0 had AO/DI (X.25) support when in fact it does not.

In the Editors' Choice sidebar of our August story "Portable Projectors," the 9.9-pound Davis DL450 should have been listed with the portable-class machines as an honorable mention, not with the conference-room units.

We stand by the evaluation. PC Labs found the GLoria XL difficult to install, and it had mostly mediocre performance results. The review mentioned ELSA's application-specific drivers. OpenGL performance was the focus of this roundup. PC Labs did not test AutoCAD because it is not an OpenGL application. Given its market share, we will consider testing high-end graphics cards under AutoCAD in our next roundup.—Ed.

HARDWARE GLUTTONY?

In response to Jim Seymour's column "Win 98's Big Display Secret" (July), I don't see much more speed or stability. To me, Windows 98's interface looks like a browser integrated with Windows 95 and USB support. Seymour also said, "We think innovation is good; they think it's dangerous—and a rich opportunity for publicity." Quite frankly, this is not innovation. Also, Microsoft needs no publicity. And if innovation causes publicity, Windows 98 will not be getting Microsoft any publicity.

DOUGLAS T. MAYER
via the Internet

Seymour must be completely out of touch with real-world PC users to suggest that Windows 98's multimonitor support is a good reason to upgrade. That suggestion is bad enough, but when he goes on to give examples of how he thinks a three- or four-monitor setup is useful—word processor open on the main 21-inch screen, e-mail program and Web browser open on each 17-inch screen to the left and right—well, that just seals it. While we're talking about such excesses, why don't we get a separate computer for each application—and maybe an entire wall of monitors? I can understand how animation studios and video production houses could make good use of multimonitor setups, but this is simply hardware gluttony.

JOHN CORKERY
via the Internet

ULTERIOR MOTIVES

John C. Dvorak's column "The Big Microsoft PR Ploy" (July) speaks the truth. Finally there is someone besides me who recognizes the free publicity that Microsoft is getting. In fact, Microsoft probably integrated IE4 into Windows 98 just to get publicity. The DOJ had a problem with Windows 95 integrated with Internet Explorer, so what made Microsoft think that integrating its browser into its next OS would go unquestioned? But the public is probably leaning toward Microsoft because of all the falsities people have heard and believed. And how is integrating IE into Windows innovation?

ADHITYA CHITTUR
via the Internet

PUSHING DIGITAL TV

In July's Inside Track, Dvorak asks why the government is pushing digital TV into the market. This is happening because a balanced budget depends on the government selling off the analog broadcast spectrum. Congress is not just pushing us toward digital: It has mandated that analog broadcasts cease forever in 2006. This will end the lives of a number of low-powered stations, many of which are minority-owned and serve small local areas and diverse cultures. The press is blaming the big broadcast corporations, which will obviously benefit from less competition, but the real culprits are in Congress and the White House. Digital TV technology is not perfected, and the changeover will cost the consumer an arm and a leg, but our concerns are irrelevant to their plan.

JEFF MANDEL
Los Angeles, California

I would like to address Dvorak's insights into HDTV: "TV seems fine to me as it is," and "I can see the picture okay." Gee, John, and do you still enjoy playing Pong?

DICK JARVINEN
via the Internet

DOING THE MATH

In the Pipeline article "Digital Econ 101" (June 9, page 10), you quote Secretary of Commerce William M. Daley as saying that "65,000 [Web sites] are being added—every hour," and that 100 million people logged on to the Internet last year. No wonder I have so much trouble connecting with my ISP. With 8,760 hours in each year, that would be 569,400,000 Web sites added last year, or more than 5 new sites for every person who logged on.

TERRY A. RUSTIN
Houston, Texas

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Trends

The Wired Campus

Technology is radically changing college life.

Micheline Jedrey, Wellesley College librarian and director of information services, is eloquent in summing up how digital technology, and specifically the Internet, has changed the way students and professors interact on college and university campuses around the country: "The whole notion of professors' office hours has changed."

As is true on most college campuses these days, every entering freshman at Wellesley gets an e-mail address and access to Web services. And while most Internet users around the world are still dialing up the Net on 14.4-Kbps or 28.8-Kbps modems, dorm rooms at Wellesley, equipped with Ethernet connections, offer high-speed Internet access to every student. (In academic parlance, it's known as a "port for every pillow.") Many campuses offer T1 connections in dorm rooms. "The PDAs that offer significant functionality, such as the PalmPilot, are also popular on campus," says Jedrey.

Meanwhile, commuter schools are also committed to providing Web services to students who live off campus. At New York University, where one-half of the undergraduate population lives off campus, the university runs a 56-Kbps modem pool so that students can dial in to school servers remotely.

For students who are among the few—very few—who don't have PCs on entering school (about 80 percent of the students at both Wellesley and NYU enter their freshman year with either a Macintosh or a PC), systems are available in computer labs, in the library, and in student centers.

Most campus stores are now selling both PCs and Apple Macintoshes. Five years ago, the ratio of Macintoshes to PCs at Wellesley was 4:1. Now, even though there are still a large number of Mac supporters in academia—which has traditionally been a strong market for the platform—PCs are by far the more prevalent systems on campus. At Wellesley, for example, Macintoshes now make up only about 30 percent of the student systems.

Wellesley neither discourages nor encourages use of either platform, but some schools do favor certain machines. Dartmouth College is asking freshmen arriving on campus this fall to purchase Apple's new iMac computer (it's a Dartmouth requirement to come to school with a system).

Kiosks and X terminals also adorn many of the nation's campuses, allowing students to check e-mail, print out a paper, or perform some other quick task.

College campuses are among the few places in the United States where smart cards are popular, as they are in many European countries. For instance, students at Columbia University can sign up for the university's ID card, known as the Columbia Card, which gives them low-cost banking services via the Internet. The Columbia Card also serves as an ATM card. The University of Pennsylvania, University of Michigan, and University of Florida also hand out smart cards to their students.

SCHOOL SERVICES

According to Wellesley's Jedrey, quite a few students are making decisions about where to go to school based on a school's online services, and it's clear that more and more students are using such services—like online registration—if they're available. Cleveland State University, in Ohio, currently offers online registration, applications for classes, and applications for financial aid. MIT also offers online registration. At Wellesley, roughly 70 percent of all the courses use Web technology in class in some way, whether it's to allow a student to e-mail course work to a professor or to run virtual experiments in class.

Faculty members, too, find that the Internet has drastically changed the way they do research. The Internet allows them access to materials that they would have had to take time off to get in the past, and it also gives them a more efficient way to communicate with colleagues in the same field.

There remains only one final question: With all of this technology overhauling campus life, when are you going to get a decent meal in the cafeteria?—*Angela Hickman*

America's Ten Most Wired COLLEGES

According to *Yahoo! Internet Life*'s recent survey of American colleges, these ten schools offer students the best in Web services.

MIT	University of Oregon
Northwestern University	New Jersey Institute of Technology
Emerson College	Indiana University, Bloomington
Rensselaer	Middlebury College
Dartmouth College	Carnegie Mellon University

ILLUSTRATION BY MICHAEL WITTE; CHART SOURCE: *YAHOO! INTERNET LIFE*

Dreaming of JINI

New Java technology offers Webtone for spontaneous networking.

Sun Microsystems' latest salvo in the battle against the Windows-based, PC-centric computing model is JINI (pronounced "genie"), a Java-based technology that makes sharing devices over a network—from computers to video projectors—much easier.

Masterminded by Sun's Bill Joy, JINI is Java software code that makes plugging appliances into a network as simple as plugging a telephone line into a phone jack. Once



plugged in, a device, such as a printer, announces that it is available to the network and that anyone connected to the network can call on it for printing services. Sun refers to this functionality as *spontaneous networking* or *dynamic computing*.

A typical scenario might look like this: You bring a notebook computer to a meeting and connect to an infrared port built into the surface of the conference table. The notebook joins the conference room's JINI network, announces to the network that it's there, and then starts looking for available resources, such as a printer or a video projector.

You could then drag a presentation onto the projector icon, which would turn on the projector and run the presentation. You could distribute hard copies of the presentation by dragging the file to a printer icon, which turns on the printer in the conference room and prints the documents. The whole idea carries forward Sun's Webtone concept, in which a ubiquitous network becomes as easily accessible as a phone's dial tone.

JINI will also work for home networks. John McFarlane, president of Sun's Solaris division, anticipates that JINI may become the networking smarts behind all kinds of devices, from soda machines to cars.

But JINI is likely to have some competition. Microsoft is reportedly working on a technology, code-named Millennium, that's similar to JINI.—*AH*



Delta Transfers Keep Data in Sync

When we travel, many of us find ourselves constantly needing to download the latest version of a file, such as an updated sales report or a contact database. Often, this may be a very large file, but the changes since the last download amount to only a few bytes.

Prior to Traveling Software's introduction of delta file transfer technology in LapLink for Windows in 1994, each update would transfer the entire file. Delta file transfer technology changed all that, cutting file update times dramatically by transferring only the portions of the file that had changed.

Seven of the eight products in our recent review of remote-control software ("You Can Get There from Here," September 1, 1998) now support delta file transfers, but our tests revealed differences in how the products handle the transfers.

Data is transferred over modem or a network in groups of characters or blocks that contain multiple bytes of data. A *checksum*, an algorithm that adds as little as a byte of data to each of the blocks, ensures that transfers are error-free. This byte of data contains a value that represents the data based on a calculation. When the block arrives at the destination, the value is recalculated and compared with the original checksum. If the two values are the same, it means the data was transferred successfully. Each remote-control product implements a variation of this method to determine whether data changes.

In Symantec's pcAnywhere32 8.0, our Editors' Choice, a file-synchronization feature called SpeedSend subdivides the data into block sizes that maximize performance by examining the file's binary format for repetitive bytes. SpeedSend then uses CRC32 (32-bit cyclical redundancy checking, a complex form of a checksum) to scan the block. If the values are identical, the data is the same, and the block isn't transferred. If the values are different, the block is transferred. SpeedSend is able to resync the remainder of the blocks without transferring them.

LapLink uses a similar delta methodology called SpeedSync to determine whether data blocks need to be sent. After making the transfer, SpeedSync performs data validation.

CarbonCopy32's approach is slightly different. Like pcAnywhere, it performs accuracy checking for all data transferred. For delta file transfers, it uses a 32-bit checksum on small chunks of data and stores these in a larger block for increased transfer speed.

NetOp for Windows 5.4 uses modified delta transfer, which sends the remainder of the file after the first change is detected. This process is more efficient when changes appear toward the end of the file. On our tests, this method didn't save any time over transferring the entire file.

Delta file transfer is necessary if your lifestyle requires two PCs and the synchronization of data. The extra speed it affords can make a big difference.—*Diane Jecker*

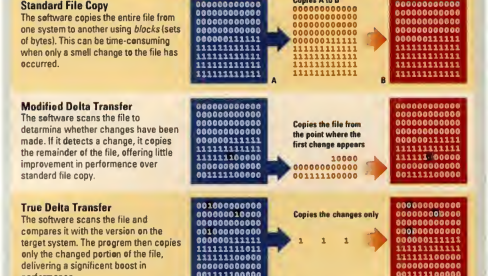


ILLUSTRATION BY WENDY GROSSMAN; PHOTOGRAPHY BY THOM O'CONNOR

New Displays Fold The Light

Rear-projection monitors could bring big changes in desktop displays.

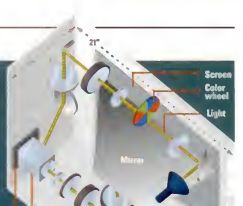
When you look at your computer display a few years from now, what will you see? To date, cathode ray tubes (CRTs) have ruled without any significant challenge, despite efforts by LCD makers to unseat the older technology. As market demand for larger screens and higher resolutions grows, however, both CRTs and LCD panels may become also-rans in the race for desk space. New technologies, including rear-projection techniques, are changing the display landscape.

As CRT screen sizes increase, a monitor's size and weight grow rapidly: A 19-inch monitor typically measures 18 inches deep and weighs more than 50 pounds. LCD monitors are attractive for their small size and sharp images, but the high cost of making large LCD panels limits these to niche-market status. Their pricing is dropping significantly, but not yet enough to compete with low-cost CRTs.

Raytheon recently demonstrated a new monitor that may be the vanguard of a new breed of computer display. Designed for military use, the 1210 DRD (Digital Ruggedized Display) has a 21-inch–diagonal viewable area and 1,280-by-1,024 resolution. The surprise comes when you look at its dimensions: 14.8 inches tall, 17.7 inches wide, and just 12.6 inches deep. And even though the ruggedized display is designed to take repeated shocks of 9g, the unit weighs 32 pounds. A model designed for a more benign environment could weigh considerably less.

Desktop Home Theater

Raytheon's rear-projection display uses a series of lenses and mirrors to fit a wide screen into a compact housing.

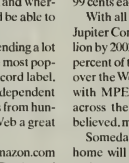


How is this possible? The 1210 DRD is actually a rear-projection display. Using a Texas Instruments DLP (Digital Light Processing) reflective chip in the unit's light engine, a series of lenses and mirrors fold the light so that it fits into the compact housing, much as in a rear-projection television. The microdisplay chip permits building the display on a smaller scale. The result is a large-format, high-resolution, bright display that has a remarkably small footprint and light weight.

Other manufacturers are also working on rear-projection desktop monitors using micropanel display engines, and retail products may be available as early as 1999.—*Alfred Poor*

JAKE KIRCHNER

Sounding Good on the Web



I don't know about you, but I have music CDs scattered throughout almost every room of the house. They're stored near the stereo in the living room, stockpiled in the children's bedrooms, piled by the computer, squirreled away in several cars, buried under piles of paper in my office, hiding in various CD travel cases, and sitting in random stacks here and there waiting to be returned to their rightful location. Finding any one CD can take days. I once found a missing, treasured CD in a kid's duffel bag in the attic, a relic of a previous year's trip to summer camp.

Wouldn't it be great if we didn't have to own CDs or tapes, if we could just listen to whatever music we want, whenever, and wherever we want to? I've been thinking that the Web should be able to provide this service.

If you're really into music, you're probably already spending a lot of time on the Internet, where music sites are among the most popular destinations. Every band you can think of, every record label, every music retailer has a site on the Web. Major and independent record labels are using the Web to promote new releases from hundreds of bands, many of them new talent, making the Web a great venue for finding new music.

You can order CDs from numerous sites, including Amazon.com (*amazon.com*), CDnow (*cdnow.com*), N2K's Music Boulevard (*musicblvd.com*), and the Tunes Network (*Tunes.com*). These sites typically offer hundreds of thousands of CDs for sale and let you sample sound clips delivered via RealNetworks' streaming audio technology, or downloaded via AT&T's a2b music technology.

And if you just want to listen to entire songs and CDs, there are a number of radio stations broadcasting over the Web, sites offering broadcasts of live music, and sites allowing you to choose among a variety of music channels. One, Spinner (*spinner.com*), has more than 100 channels for free listening.

Even more intriguing are sites such as My CD (*mycd.com*) and Custom Disk (*customdisk.com*), which let you sample and purchase single songs that you can have burned into customized CDs and delivered to your door. One new site, amplified.com from MultiPreviews, lets you sample songs using RealAudio or Liquid Audio. Amplified will create a CD for you, or you can download songs for 99 cents each and create your own CDs with a CD recorder.

With all this activity, it's not surprising that media research firm Jupiter Communications says that online music sales will top $1 billion by 2002, but actual distribution across the Web may be only 2.2 percent of that. Which is not to say that music isn't being distributed over the Web. Thousands of songs and concerts have been encoded with MPEG Layer 3 compression technology and distributed across the Web. Unfortunately, if the record labels are to be believed, much of the MP3 activity is bootlegged material.

Someday all this will sort itself out. Increased bandwidth to the home will help. Launch Media, with its Launch CD-ROM and mylaunch.com site, is currently testing delivery of its multimedia music content via @Home and MediaOne cable modem services.

And someday we'll have wireless networking and fully networked homes and cars, and we'll be able to listen to whatever we want whenever we want. And someday my kids will learn to empty their duffel bags and clean their rooms.

PHOTOGRAPH BY SHONNA VALESKA

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DESKTOP PCs

Home on the Range

With the back-to-school season upon us, several major PC manufacturers—including Acer, Gateway, IBM, and Micron—have made notable changes to their home PC offerings in recent weeks, with the goal of improving the home PC experience.

Using AMD's latest processor—the K6-2—Acer and IBM are offering new $999 machines through retail outlets. Gateway and Micron direct-vendor prices are still highly attractive, even though they continue to use Intel chips. Micron, which remains the only major direct vendor selling sub-$1,000 systems, has adopted Intel's Celeron chip and a smaller case design, whereas Gateway has introduced a seminal PC trade-in program designed to lower the long-term cost of owning a system.

The new Aspire series from Acer America Corp. (*800-733-2237, www.acer.co/aac*) starts with two $999 systems, the **Acer Aspire 1860** and the **Acer Aspire 6058**. The 1860 is a 300-MHz AMD K6-2 system; the 6058 uses a 300-MHz Pentium II CPU. Whereas the AMD model includes 64MB of SDRAM and a 5.1GB hard disk, the Pentium systems start with 48MB of RAM and a 4.8GB hard disk. The next tier up features the **Acer Aspire 1870**. Each offers color-coded cables for easy setup, two USB ports, and a new internal design with a swing-out drive cage for simplified upgrades. Soon, Acer will equip each new machine with a USB keyboard and mouse. The keyboard will plug into the PC's motherboard, while the mouse will be conveniently attached to the side of the keyboard.

In an effort to make the PC experience more painless for newcomers, Acer includes My Aspire Guide, a suite of help applications that's customized for each system and provides step-by-step instructions for adding memory and upgrading the CPU; the guide also acts as a system diagnostic center.

In addition, Acer systems feature the ACE Desktop, a shell for simplifying Windows navigation, and InternetACE, a customizable Web browser based on Microsoft Internet Explorer 4.0 that's preconfigured with links to popular Web sites and a search engine geared toward children. Windows shells may be close to extinction in the home market, but Acer still sees value in the ACE Desktop.

Each system in the new Aspire line comes with an ATI Rage Pro/II+ graphics accelerator, a 24X CD-ROM drive (32X on the 6058), and a 56.6-Kbps V.90-compatible modem. An optional 15-inch monitor is available for $199. Acer also has a K6-2 333-MHz system ($1,200 street) and a Pentium II 333-MHz system ($1,300 street).

IBM Corp. is targeting the sub-$1,000 market with two new Aptiva systems priced below $1,000: the **IBM Aptiva E2N** and the **IBM Aptiva E3N** (*800-426-7235, ext. 4340, www.ibm.com*).

In addition to Lotus SmartSuite, these consumer systems provide a 100 hour free trial with America Online (upon joining AOL, you'll get a $175 IBM mail-in rebate coupon) and 50 free hours with the IBM Internet Connection.

The E2N ($800 street) is a 266-MHz AMD K6-2 system with 32MB of SDRAM, a 4GB hard disk, a 32X CD-ROM drive, ATI Rage Pro Turbo AGP graphics, a 56.6-Kbps V.90-compatible modem, and two USB ports; the E3N ($1,000 street) is similar but include a 300-MHz K6-2, 64MB of SDRAM, and a 6GB hard disk.



HOME WONDERS: *(clockwise from top) Systems from Acer, Gateway, IBM, and Micron.*

Addressing the high end of the consumer market is the **IBM Aptiva E5D** ($1,800 street), which comes standard with a 400-MHz Pentium II, 64MB of RAM, a 6GB hard disk, a second-generation DVD-ROM drive, an ATI Rage Pro 2X Turbo AGP graphics card, and a 56.6-Kbps V.90 modem. The Aptiva line does not include a monitor; you can purchase a 15-inch monitor separately for $250 (street).

Micron Electronics (*888-642-7662, www.micronpc.com*) is forging ahead in the sub-$1,000 market with two Celeron systems, the **Micron Millennia C266** and the **Micron Millennia C300**.

Both systems use a new cost-cutting microATX motherboard. Micron has found other ways to keep the costs down; for example, the 64-bit wavetable PCI sound and 4MB nVidia RIVA 128 AGP video are integrated on the the motherboard. And there are plans to integrate the modem as well.

A 266-MHz Celeron system, the Millennia C-266 is priced at $999 (direct); with a 15-inch monitor, the price increases to $1,199. The Millennia C-300, priced at $1,249 (direct, including monitor) bumps the speed up one notch to 300-MHz. Aside from CPU speed, both systems are virtually identical, featuring 32MB of SDRAM, a 4.3GB hard disk, a 32X CD-ROM, and a 56.6-Kbps V.90 modem.

Taking a different approach is Gateway (*800-846-2000, www.gateway.com*). The G-Series is a home line that's available through Gateway's new purchasing plan, which is unique for a direct vendor.

Purchase the 350-MHz Pentium II **Gateway G6-350** ($1,999 direct) under the company's Your:)Ware Program, and you'll pay $64 a month for it, including the finance plan's minimum 14.9 percent APR. There is a slight advantage to buying the G6 via Gateway's finance plan: After two years of ownership, you can put the wholesale value of the machine toward a more up-to-date system. To be eligible, you must use the finance plan and either sign up for 6 months of *gateway.net* Internet service ($14.95 a month) or purchase a software package.

The G6 comes with 64MB of SDRAM, an 8.4GB hard disk, an nVidia 8MB graphics card, a 56.6-Kbps V.90 modem, a second-generation DVD-ROM drive, and a 17-inch monitor.—*Rich Brown*

RECAP *PC Magazine* tested 37 sub-$1,000 PCs in our issue of September 1, 1998. The Axis Orion LXN266 was our Editors' Choice, while systems from Acer, IBM, and Micro Express were honorable mentions.

GRAPHICS

Image Magic

Now that you have that scanner or digital camera, a whole new world of digital imaging is open to you. And in anticipation of another busy holiday season for the burgeoning digital photography market, the major graphics software vendors are readying improved versions of their consumer image-editing software, emphasizing such conveniences as direct links to digital cameras and scanners, more professional-looking templates, and tighter integration with the Internet.

Putting more control over imaging into the hands of home users is **Adobe PhotoDeluxe Home Edition 3.0** ($50 street), from graphics stalwart Adobe Systems (800-272-3623, *www.adobe.com*). This version builds on Adobe's popular step-by-step interface that guides novices through the world of image editing and adds such features as templates for printing multiple images on one page, compatibility with Photoshop plug-ins, and a simpler method for acquiring images from digital cameras and scanners.

The interface has been revamped to include a three-tabbed panel at the top of your screen; each of these menus direct you to Adobe's Guided Activities, wizards that step you through common tasks. Advanced Menus are available to give more experienced users direct access to tools via pull-down menus.

Using the Get and Fix Photo features, you can easily adjust the look of your images with tools for cropping, changing contrast and color, and adding special effects. Use Cards and More to create common projects, such as calendars and cards. With the new PhotoParade slide show feature, you can can select from themes that include animation and sound and then insert your images to create your own slide show. The included PhotoDeluxe viewer is required in order to watch the slide show. The third panel, Connectables, provides an easy way to download updates, such as new templates, without having to load your browser and search these sites.

One of the most significant additions to PhotoDeluxe is the ability to print multiple pictures on one sheet of paper—a big advantage when you consider that quality photo paper can cost around $1 per sheet. The templates let you place multiple images of varying size on one sheet of paper; unfortunately, the selection of templates is limited and you can't create your own layouts.



FUN WITH PHOTOS: *(Clockwise from top) Adobe PhotoDeluxe Home Edition 3.0, Microsoft Picture It! 99, and MGI's PhotoSuite II.*

Keeping in step with Adobe, Microsoft Corp. (800-426-9400, *www.microsoft.com*) will be releasing a new version of **Microsoft Picture It! 99**, ($50 street). Major new features include better links to digital cameras and scanners, expanded photo-editing tools, and more content.

Using the more advanced drivers in Windows 98, Picture It! 99 can now download batches of photos directly from most digital cameras. The program includes a new still image architecture that automatically wakes up the PC and scans an image you insert in a scanner—assuming you already have Picture It! 99 loaded.

Quick Touchup provides instant access to the most commonly used tools and adjustments, including crop, remove red-eye, rotate, brightness, contrast, and tint. Picture It! 99 also has a cloning tool for painting one part of an image onto another part. You can now select parts of an image based on their color as well as skew and de-skew images. The wrinkle/blemish remover, along with a tool called Old to New, are useful for restoring old photographs. Picture It! 99 is bundled with two CD-ROMs with new content and project templates.

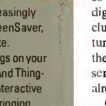
The new version is actually part of Microsoft's forthcoming Graphics Studio line. **Microsoft Graphics Studio Home Publishing 99** ($50 street) includes Picture It! Express and adds a vast collection of desktop publishing projects for print and the Web. Among the 8,500 project templates are calendars, crafts, party sets, personal Web pages, and e-mail greetings. Stepping up to the **Home Publishing Suite 99** ($55 street) gives you the full version of Picture It! 99.

MGI (800-403-4835, *www.mgisoft.com*) has taken its popular PhotoSuite program and redesigned it from the ground up. **PhotoSuite II** ($60 street) provides direct access to digital cameras and scanners, tight Internet integration, and 500 new project templates.

The new interface was built using Dynamic HTML and consists of six modules: Photo, Projects, Album, Slide Show, Internet, and Guides. New editing tools include: Magic Scissors for selecting objects in an image; dodge and burn for lightening and darkening specific areas; automatic touch-up; and red-eye removal; and support for borders, frames, and shadows.

PhotoSuite II also offers a new collection of effects, called Warp and Fun House Mirrors, for turning ordinary photos into bizarre images. You can convert albums to Web pages and create slide shows of images with background music and video-style transitions.—*Matthew Graven*

Thing Power



Parable (800-796-0860, *www.thingworld.com*) first created a stir with ThingMaker, a clever object-oriented, drag-and-drop application that makes it easy to create multimedia elements for use on the Internet. Parable is building on its increasingly popular universe by offering ThingCollector and ThingsScreenSaver, both of which are being previewed at ThingMaker's Web site.

With ThingCollector, you can now organize and store Things on your hard disk, so you may interact with them locally at any time. And ThingScreenSaver lets you take your Things and make them into interactive screensavers. Meanwhile, the company has been active in bringing aboard content partners that will provide Things for their online users. The latest addition to Parable's growing list is Comedy Central, which offers South Park Things at *www.comedycentral.com*.—*Melissa J. Perenson*

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pentium II





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This powerful department-class server is loaded with extras.

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GRAPHICS ACCELERATORS

One-Upping the One-Uppers

Round three in the fight to control your PC graphics has begun, as chip and board makers trot out the third generation of 2-D/3-D graphics accelerators to woo PC vendors and retail buyers. The game of one-upmanship continues with better, faster 3-D.

The other big news: Memory is so cheap (and the demands of 3-D so great) that many makers are forgoing 4MB versions of their boards—the typical configuration for mainstream PCs in the past year—and delivering 8MB cards for the former 4MB prices. At $250, even 16MB cards are now relatively affordable. There are also fancy new 3-D graphics effects, including bump mapping (where textures can take on 3-D effects of their own, such as the rough surface of a brick wall) and anisotropic filtering (which cuts down on distortion when textures are applied to tilted surfaces).

The new **Hercules Terminator Beast** card. (800-532-0600, *www.hercules.com*) uses S3's Savage3D integrated 2-D/3-D graphics chip. Targeted at power users of both Windows productivity applications and graphics-intensive games, the 8MB AGP iteration should sell for around $130 on the street.



RAGE TO THE FINISH: *Number Nine's new 2-D/3-D accelerator.*

Also this fall, STB Systems (888-234-8750, *www.stb.com*) is releasing its **STB Nitro 3200**, which is based on the Savage3D. Pricing is expected to be less than $150 (street), and like Hercules, STB is skipping the 4MB memory plateau and going right to an 8MB version. This AGP card features a 250-MHz RAMDAC and TV-out support so you can view the computer image on a TV monitor.

Another chip arrival is the RIVA TNT from nVidia. The company's previous generation, the RIVA 128, delivered the fastest 3-D performance of any integrated 2-D/3-D solution when we tested the field (see "New Technology, New Speed," December 2, 1997). Diamond Multimedia offers the TNT-based **Diamond Viper V550**, which is available in both AGP and PCI versions (800-468-5846, *www.diamondmm.com*). Diamond is skipping 4MB and even 8MB with this offering; the 16MB version will be about $250 on the street—$50 less than the typical price of an 8MB board a year ago.

Number Nine Visual Technology (617-674-0009, *www.nine.com*) plans to have its fourth-generation 2-D/3-D accelerator in stores in the third quarter, and its price is even more impressive. The 16MB **Number Nine Revolution IV**, based on the company's own Ticket to Ride IV chip, will sell for $170 on the street.

Another new chip set hitting the streets before year's end is the second-generation PowerVR from NEC Electronics and VideoLogic (408-588-5558, *www.powervr.com*). The PowerVR technology is being used in Sega's game consoles in the consumer electronics space, and the company is bringing a family of new chips using the latest tricks to the PC arena. The company expects major board makers to use the chips on cards aimed at PC gamers and the retail upgrade market (some as low as $99) in early 1999.—*Jamie M. Bsales*

STORAGE

Faster Recordable CD

Recordable DVD solutions, such as DVD-RAM and DVD+RW, may (still) be just around the corner, but for many users, recordable CD drives remain a better option. Even though the capacity of recordable DVD—2.6GB and up—is spectacular, the first generation drives won't allow you to create CD disks that you can distribute for use in any CD-ROM or DVD-ROM drive. A 650MB compact disk–recordable (CD-R) or compact disk–rewritable (CD-RW) drive, on the other hand, creates disks that can be read by most any CD-ROM, DVD-ROM, or audio CD player.

Smart and Friendly (800-959-7001, *www.smartandfriendly.com*) is the first out with a CD-R burner that writes disks at an impressive 8X speed—that's just 9 minutes for a full CD. The **Smart and Friendly CD Rocket** ($999 list) reads CDs at 20X, and the software bundle includes the usual CD mastering software, as well as Sonic Foundry's Sound Forge for building professional-quality sound tracks and music.



RECORDING FRENZY: *NEC and Micro Solutions (above left).*

NEC Technologies has a unique spin with its three-in-one **NEC Multi CD-R** ($350 street). This drive reads CDs at 20X speed, writes CD-R media at 2X speed, and can read, write, and rewrite 650-MB phase-change PD/CD cartridges (about $25 apiece). Introduced by Panasonic in 1995, PD technology is fast and robust, but it only garnered a niche following in the PC market. The Multi CD-R lets you write to CD-R disks for files you need to distribute to others (or for creating audio CDs) and to PD media for personal backup and archiving. NEC claims PD is better than the competing CD-RW standard for such tasks because the cartridges are less prone to wear and damage than CD-RW disks. Another plus: Some first-generation DVD-RAM drives will read PD cartridges, too. The Multi CD-R drive is being distributed domestically for NEC by Kanematsu USA (732-271-7393, *www.multicdr.com*).

RECAP In our March 10 roundup of 24 CD-R and CD-RW drives, we awarded the Editors' Choice to drives from Philips and Smart and Friendly.

For mobile users, Micro Solutions is offering two new portable CD-RW drives in its line of **Micro Solutions backpack cd-rewriters** (800-890-7227, *www.microsolutions.com*). Each 4.1-pound drive can connect easily to your laptop's parallel port, and the 650MB capacity makes each one ideal for storing and transporting large presentation files, e-mail archives, and the like. As with all CD-RW drives, you can create read-once CD-R media to share with CD-ROM users, use the rewritable CD-RW media for backup and archiving, and read CD-ROM disks. The 2X CD-R/2X CD-RW/6X CD-ROM version costs around $500 on the street, and the 4X CD-R/2X CD-RW/6X CD-ROM version runs $600.—*JMB*



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LIST SERVERS

Lasso Your E-mail

As e-mail increasingly becomes a primary means of communicating, list servers and e-mail services are becoming more important to businesses. List servers automate the administration of mailing lists, and e-mail services can manage subscription lists, provide delivery services, and generate reports. The following products can help you with these tasks.

Designed specifically for Microsoft Windows NT or Windows 95, Mustang Software's **Mustang Web Essentials ListCaster** (805-873-2500, *www.mustang.com/listcaster*) is a list server that takes advantage of Active Server Pages in Microsoft IIS. Mustang recently released Version 2.0 ($499 list), which adds such features as customizable templates, built-in message probing, and an optional subscription confirmation system that prevents users from subscribing others to a list without their knowledge.

You can use ListCaster's SMTP/POP3 mail gateway or you can use your current SMTP setup. ListCaster lets you set up an unlimited number of lists that have no limit on the number of subscribers in each. Mailing list configuration, subscriber data, and messages are all stored in database tables.

The templates let you set up custom responses to various control messages from subscribers. You can include macros in the templates for inserting dynamic data, such as subscriber options, from the database.

L-Soft International's **Listserv** (800-399-5449, *www.lsoft.com/listserve.stm*) lets you manage and control mailing lists on a corporate network or on the Internet. Graduated charging lets individual departments start their own Listserv service for $500 to $1,000 a year. No technical knowledge is required in order to use Listserv.



MANAGED E-MAIL: *Listserv can automatically forward user requests.*

Whether your Listserv operation is decentralized or not, users will see the same single-system view, which eliminates a need for organizational details. For example, when a user requests to join a particular mailing list, Listserv finds the machine this list is located on and automatically forwards the user's request.

For those who want their e-mail tasks managed out-of-house, **InfoBeat Express** from InfoBeat (*www.infobeatexpress.com*) may be the way to go. A 500,000-message program costs $5,000 to $10,000 per month, depending on the degree of customization.

InfoBeat Express offers e-mail services—including subscription list management, message construction, delivery services, Web-based reporting, and customer service for e-mail publications.

InfoBeat Express' proprietary technology can send as many as six million messages per hour in a broadcast mode.—*Doug Beizer*

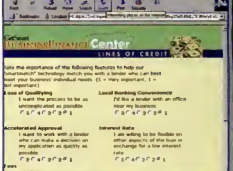
WEB FINANCIAL SERVICES

Small Business Seed Money

Getting a loan to support a small business has always been a hassle. Two free Internet loan services are offering the little guy some financial respite by simplifying the loan application process.

GetSmart's (*www.getsmart.com*) **Business Finance Center** matches business owners with prospective lenders. Users select the type of financing they're looking for—line of credit, equipment, business, real estate loan, or accounts receivable financing—and fill out the site's proprietary SmartMatch application, a short test that records loan preferences as well as business and credit history. Once submitted, the SmartMatch information is used to generate a list of appropriate lenders from GetSmart's 14-member base for small businesses. Users consent to be contacted by phone, and lenders usually get in touch within 36 hours.

Intuit's **Quicken Business CashFinder** (*www.cashfinder.com*) is a Web-based service and downloadable software application that automates the credit application process. On the site, business owners review more than 30 credit options proposed by 10 participating financial institutions (such as American Express, Chase Manhattan, and Citibank) and choose the options they want to pursue. Business owners then download the CashFinder software, which simultaneously fills out multiple credit applications based on answers submitted during an extensive business "interview." Applications are printed out, signed, and sent by mail. Financial institutions generally respond to applications within 48 hours of receipt.—*Emily Cohen*



FIND CAPITAL: *GetSmart's application matches you with a lender.*

Protecting Your In-Box



Inspired by the model of computer virus protection packages that are updated regularly to keep up with new offenders, Bright Light Technologies' new **Bright Mail** (*www.brightlight.com*) can help protect you from spam e-mail.

Bright Mail's system has a three-pronged approach to stopping spam. The Probe Network is a massive number of e-mail addresses established for the sole purpose of receiving spam. The Bright Light Operations Center evaluates newly detected spam and issues rules for ISPs. The third approach is the Spam Wall, a filtering engine that identifies and screens out spam based on the updates from the Bright Lights Operations Center. The service is now available through such national ISPs as AT&T WorldNet Service, Concentric Network, EarthLink Network, and free Web-based e-mail provider USA.net. A year license for Bright Light starts at $10,000 for up to 2,000 seats.—*Doug Beizer*

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PC CARDS

New Combo Connections

The combination of modem and Ethernet connectivity on a single PC Card has already proven a boon to road warriors.

New developments provide even more benefits. The use of 32-bit CardBus technology lets the PC Card do its own processing and sidestep the laptop's CPU. This results in faster performance and removes a speed bottleneck when using an Ethernet connection. ISDN connectivity is also becoming more widely available, which means you can take advantage of fast connections while on the move. So far, the new V.90 56.6-Kbps standard remains a flash upgrade option; the three products below adhere to the K56flex standard.

Ositech's **Jack of Spades** ($239 list) is among the first PC combo cards to implement the new 32-bit CardBus technology (888-674-8324, *www.ositech.com*). In addition to the faster interface, the Jack of Spades includes a 56.6-Kbps modem, a 10/100 Fast Ethernet network connector, and Ositech's Digital Phone Interface (DPI) technology. With DPI, you can use one RJ-9 handset adapter to connect to nearly any phone in the world, relieving the burden of having to lug around a separate adapter for each country you visit.

Psion Dacom (978-369-0655, *www.psiondacom.com*), one of the first companies to release a four-function PC Card, uses the 32-bit CardBus to push performance up a notch on the **Psion Dacom Gold Card NetGlobal** ($269 list). The NetGlobal packs a 56.6-Kbps modem, a 10/100 Ethernet port, PCS/GSM cellular phone connectivity, and an ISDN connection (requires an optional $229 cable kit)—all on a single PC Card.

Similarly crammed with features, the **56K Global Communicator** ($299 list) from Simple Technology aims to provide any connection you need anywhere in the world (800-367-7330, *www.simpletech.com*). The Global Communicator includes a flash-upgradable 56.6-Kbps modem, GSM cellular support, a 10/100 Ethernet port, and ISDN connectivity on a single PC card. In order to use the Ethernet or ISDN connectivity, you'll need an optional $129.95 cable kit for each. For world travelers, Simple provides software that configures the card for eight different countries.—*Michael N. Rusignuolo*



NETWORK MAPPING

Diagram Your Network

Getting a handle on your steadily growing LAN can be a huge task, especially when contending with the time-consuming chore of tracking all of your equipment. Two companies have new products that help you physically map out your network.

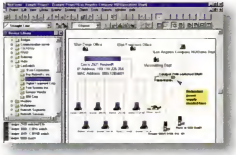
Micrografx (800-417-8314, *www.micrografx.com*) now offers two products for network organization: **NetworkCharter** and **NetworkCharter Pro**, ($349 list and $995 list, respectively). NetworkCharter's Discovery function locates all of the devices on your LAN and charts them in a graph or table. NetworkCharter can locate up to 150 devices; for finding an unlimited number of devices, you'll have to upgrade to NetworkCharter Pro, which finds all devices sitting behind a router segment.

Once charted, you can see a graphical representation of your entire network, making new hardware and connections much easier to add. If you're setting up a new LAN, design wizards guide you through the complex process and check your information against the library rules and specifications. Flexible documentation features let you customize reports using an extensive library, containing specifications for over 5,000 devices and components in NetworkCharter and over 10,000 in NetworkCharter Pro. To receive the latest updates, a library subscription option is available to Pro users for $400 a year.

Long-time player Visio Corp. (800-248-4746, *www.visio.com*) has added a new level of functionality to its Visio Professional 5.0 diagramming package with the **Visio Solution Pack for Novell Directory Services (NDS).** The Solution Pack is the first and only low-cost, drag-and-drop diagramming tool available for Novell directory structures. The Pack is a free download from the Visio Web site but requires that Visio Professional 5.0 ($350 street) already be installed.

Included in the pack are over 40 SmartShapes objects that correspond to the container and leaf objects found in NDS. Each shape contains the attributes—such as log-on name and network address—that are necessary to create new NDS objects.

The Pack can both read from and write to your NDS database, saving any changes you make in Visio back to your NDS structure. It's also able to graph the entire NDS tree, which means you can create an organizational view of an NDS structure that includes relationships between peer devices not viewable in a horizontal tree view.—*Adam Asch*



PICTURE PERFECT: *Micrografx NetworkCharter locates and charts network devices.*

Data Vault

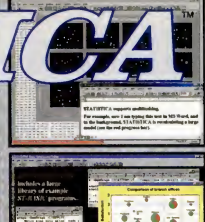
Direct vendor Dell Computer Corp. is making its entrance into the high-volume storage market with the **Dell PowerVault 650F**, the first enterprise storage system based fully on Fibre Channel RAID technology. Prices start at $15,000 and go up to $100,000 for fully configured systems.

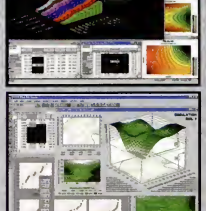


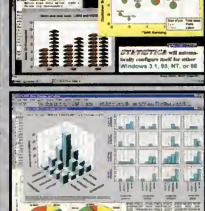
The PowerVault 650F incorporates the latest enterprise technologies, including Pentium II Xeon chips, PCI hot-swap capability, and Fibre Channel storage. The rack-mountable system will include dual-ported Fibre Channel disks, taking advantage of Fibre Channel's high data transmission rate of 1GB per second. Dell lets you configure the Power Vault with up to 120 disks, giving it a storage capacity of over 2 TB. A single Dell server will be able to access up to three PowerVault systems, for a total of over 6TB of storage on one server. Also included are redundant RAID controllers, power supplies, power cords, and fans.—*Carol Mangis*

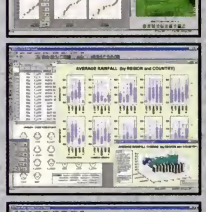
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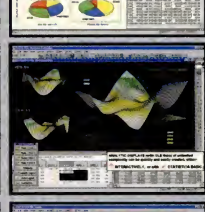


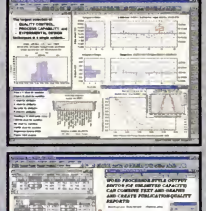


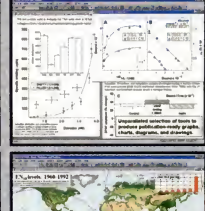


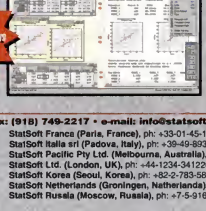


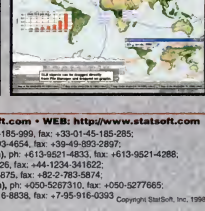












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	VisionMaster Pro 501 (19.5" VIS)	TCO '95	0.26mm/AG	96khz	1600 x 1200@75hz	$999
	VisionMaster 502 (19.5" VIS)	TCO '95	0.27mm/dp	110khz	1800 x 1440@74hz	$1,059
	VisionMaster 501 (19.5" VIS)	TCO '95	0.27mm/dp	96khz	1600 x 1200@75hz	$999
19"	VisionMaster 450 (18.0" VIS)	TCO '95	0.26mm/dp	102khz	1600 x 1200@80hz	$699
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First Looks



LCD Monitors Go Digital

Falling prices, improved picture quality, and new, all-digital interfaces make flat-panel desktop monitors a reality for more users.

By Alfred Poor

There's no doubt that LCD (liquid crystal display) desktop monitors look great—almost everybody wants one. For now, comparatively few people have them, primarily because they cost much more than a similar-size CRT (cathode ray tube) monitor and do not suit a typical user's budget. And there are some image-quality problems that can make an LCD monitor less appealing.

Those problems may just be on the verge of disappearing. How? First, increased LCD manufacturing capacity worldwide and better production yields have helped to drive panel costs down in recent months. Second, and even bigger news, is that digital interfaces now make it possible to improve image quality while lowering prices.

THE DIGITAL DIRECTION

Digital connections for LCD panels are nothing new: Notebook computers have used these connections for years, because they simplify the graphics and display circuitry required for the system and create a better-quality image. Desktop LCD monitors that used digital interfaces generally have not been favored in the market. Why? Such a panel required a specific, proprietary graphics card, which in many cases didn't provide an attractive enough ratio of price to performance for the end user.

Instead, display manufacturers focused on creating LCD monitors that could connect to the standard VGA analog port on just about any graphics card. Though easier for the buyer, this created problems for the manufacturer. To understand the nature of these problems, we need to follow the path that image data takes through your computer.

Images start off as digital data, calculated by the PC's processor and the graphics accelerator, and then stored in video buffer memory on the graphics card. On a typical graphics card, this data is run through a digital-to-analog converter (DAC), which changes the digital on/off bits of information into a series of analog waves. These waves are then transmitted to the monitor through a set of five wires that are connected to the monitor (one each for red, green, and blue, plus horizontal and vertical synchronization signals).

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PAGING PALMPILOT:
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PHOTOGRAPHY BY THOM O'CONNOR

This analog wave information is particularly well suited to CRT operation, as the wave forms can be used to modify the monitor's electron gun beams as they play across the inside surface of the monitor, increasing and decreasing the intensity of the beam to create brighter or dimmer pixels. A small amount of information is lost in the translation from digital to analog signals, but generally the difference is not enough to be noticeable—given the limitations of human visual perception and the CRT's ability to reproduce subtle signal differences.

LCD monitors, on the other hand, fundamentally are digital products. The pixel calculated by the display driver in the computer corresponds precisely to a specific set of liquid crystal cells on the LCD monitor. Converting the digital data in the computer to analog data for transmission to the panel and then converting the data back again to digital information at the panel degrades image quality and is unnecessary.

An LCD monitor may not be able to calculate the precise pixel location for a given amount of information. As a result, some screen images and patterns may cause unwanted visual artifacts such as banding or jittery pixels. Most analog LCD monitors have phase and clock controls to help adjust the monitor's circuitry to process the signal as accurately as possible. But it's rare that all of these artifacts can be eliminated.

DIGITAL DIFFERENCES

With a digital interface, there are no phase or clock adjustments required; each pixel is displayed in precisely the right spot. There is also no flicker from slow refresh rates on an LCD panel, so you can set your graphics card to a 60-Hz refresh rate, which can free up card bandwidth for faster image processing. All data travels to the monitor without error being introduced by two conversions, so a black pixel is displayed as black instead of dark gray, for instance. The result is a stunningly high-contrast image, which makes pictures look better and text look sharper.

Best of all, the manufacturer doesn't have to build expensive analog-to-digital signal conversion hardware into the LCD monitor. According to some sources, this can save between $150 and $200 in production costs. Now that prices for 15-inch diagonal panels have fallen to $1,000 and below, this savings can represent a significant portion of the end-user cost.

The display industry has been struggling to establish a series of standards to cover the digital interface for desktop monitors (see the sidebar). But the whole market segment got a jump start this past summer when Compaq released its new Presario 5600 series of home PCs with a new flat-panel monitor—the FP500. The display uses a digital interface, but instead of a proprietary card, the system comes with a new AGP graphics accelerator card from ATI Technologies—the Xpert LCD. This single card has a standard 15-pin analog SVGA connector plus a video output to connect to a television, and a new 20-pin connector for a digital monitor.

You can expect to see your options expand even further in the near future. Compaq is part of the Digital Flat Panel (DFP) Working Group that is developing a standard interface. Other major companies besides ATI have also joined the group, including Matrox and STB among graphics card manufacturers, and monitor manufacturers Acer, MAG Innovision, Princeton, and ViewSonic. This may well become the critical mass required to establish a set of standards quickly.

For this roundup, we took a close look at the Compaq Presario FP500 and the Princeton DPP 500 monitors, each of which uses the same interface and works with the ATI Xpert LCD card, which uses the Rage 3-D LT Pro chip. We also compared these with the Toshiba TekBright 50D, which uses a proprietary card, and the modernistic, two-panel STB Galileo 15.

As you'll see from the reviews, one point is as clear as the images on these screens: Digital desktop monitors with digital interfaces are visibly better than similar products that try to work with analog interfaces. Add the lower production costs and broad-based support among key manufacturers, and chances are good that you'll see a space-saving, eye-popping, flat-panel monitor on a desk near you in the near future.

Has the Standards Race Already Been Run?

Whenever a standards dispute arises, so does the ghost of the infamous VHS-versus-Betamax struggle in the early days of videocassette recorders. But in the debate about digital panel interfaces, there's a good chance that the struggle is already all over except for the shouting.

There are many different overlapping and competing standards. The proliferation arises from the fact that there are different parts of the engineering puzzle to solve, and different companies are working to find their own solutions. One of the key problems is getting data from the graphics card to the panel rapidly enough. EGA monitors sent image data in parallel over six separate signal wires, six bits per pixel; this resulted in a very limited color palette.

The better approach is to send high-speed serial data across fewer signal wires and then reassemble the pixel data for display. This approach requires remarkably fast transfer rates—more than 3 *gigabits* per second.

FACE-OFF

Currently, there are two competing camps to set the standard for this transfer technology. **LVDS** (Low-Voltage Differential Signaling) is a design used widely in notebook panel connections and is championed for desktop monitor use by National Semiconductor, Number Nine, and Silicon Graphics, among others. The other side has chosen the **PanelLink** technology developed by Silicon Image of Cupertino, California, which provides transmitter and receiver chips to transfer data using TMDS (Transition Minimized Differential Signaling), which is a standard backed by VESA (Video Electronics Standards Association).

The LVDS camp contends that there are technical problems with implementing PanelLink in production quantities, and that the technology is not capable of handling high-resolution displays above 1,280-by-1,024 (SXGA). The companies also point out that, at present, PanelLink products depend on a single source (Silicon Image) for key components.

On the other side, the PanelLink supporters state that their solution is simpler: The connection depends on just three pairs of wires compared with the four pairs for LVDS. PanelLink connections can be run over standard twisted pairs and over distances up to five meters. And the TMDS technology has been chosen by VESA for both its Flat Panel Display-2 (DFP-2) standard for notebooks and its Plug and Display (P&D) stan-

Compaq Computer Corp.

Compaq Presario FP500

The Compaq Presario FP500 is the bellwether monitor for digital desktop displays. And at $1,000 (street) for a 14.1-inch–viewable, 1,024-by-768 resolution display, the unit is priced only slightly higher than some top-of-the-line 17-inch monitors that provide a functionally equivalent image.

The monitor uses a DFP standard 20-pin PanelLink digital connection; we used an ATI Xpert LCD ($150 street) graphics adapter for testing. Installation and setup are simple: Plug in the power and connect the data cable to the graphics adapter, power up, and you're ready to go.

As with the other digital panels in this group, there were no image size or position adjustments to make, contrast controls, or clock and phase settings to tweak. In fact, the only controls are the power switch and the brightness control—and the brightness adjustments covered a limited range at that.

The FP500 excels at displaying high- and low-end levels of gray, even without conventional brightness and contrast adjustments. The panel is better at displaying detail in shadow or bright areas of an image than the vast majority of standard CRT displays. The pixel tracking and moiré tests resulted in Gibraltar-steady images that are found only with digital interface displays.



Compaq Presario FP500
Street price: $1,000
Compaq Computer Corp., Houston; 800-345-1518, 281-370-0670
www.compaq.com

Color tracking was excellent (there were no undesirable colored tints to any gray levels) and 256-step color ramps were smooth and unbroken, though there was a bit of an abrupt drop-off at the lowest levels. Text was crystal clear, with 9-pixel text (6.8 points) easily legible.

The monitor has one flaw that detracted from its image quality. Compared with some, the FP500's LCD panel has a rather limited viewing angle. If you view from off-axis—especially in the vertical plane—the image quality suffers, and in some cases, the image shades will actually reverse. This problem is most visible when looking from below and to the side of the screen. Less of a problem but still noticeable are the dark and light regions around the edge of the panel.

This monitor is built to accommodate multimedia, with a pair of JBL speakers designed to clip on the sides of the panel like a pair of mouse ears. The display also has a built-in microphone.

The Compaq Presario FP500 is a worthy candidate for its vanguard position. The price is within reach of many users, and its image quality is difficult to match with any CRT. Its compact size and light weight—14 pounds—deliver a large viewing area to even cramped working settings. This unit is an excellent choice for a flat-panel desktop monitor.

Princeton

Princeton DPP 500

In this new field of digital desktop monitors, the Princeton DPP 500 is the value leader. Unlike the Compaq offering, Princeton's 14-inch, 1,024-by-768 resolution display also includes an ATI Xpert LCD graphics adapter with the Rage LT Pro 3-D accelerator chip. With an estimated street price of $950, this package comes close to parity with the cost of a 17-inch CRT and equivalent graphics card.

As with the Compaq, the only controls on the DPP 500 are power and brightness. Though the monitor had the same deep-space blacks as the Compaq unit, the DPP 500 was not able to produce the dark and light shades of gray as well. The DPP 500 also had two bright pixel defects—one of which appeared midway through our testing. The monitor's viewing angle was better than the Compaq's but was still weak when viewed from above or below.

Color tones were excellent, and there were no color-tracking flaws. Images were rock solid, and 9-pixel text was easy to read. The backlight illumination showed excellent uniformity across the entire screen. The only minor flaws were a bit of banding in the 256-color ramps and some faint ghosting that was barely noticeable.



Princeton DPP 500
Street price: $950
Princeton, Santa Ana, CA; 800-747-6249, 714-751-8405
www.prgr.com
401 at www.pcmag.com/infolink.

This panel is able to scale up lower resolutions to fill the screen. It also does a good job with 800-by-600 images using anti-aliasing techniques to smooth scaled text and images. The DPP 500 has built-in stereo speakers, which sounded a bit thin, and a microphone.

Although the panel may not be able to recreate dark and light details as well as some of the others, the Princeton DPP 500 is an attractive monitor—both in

dard for the desktop monitor digital interface.

Perhaps the most important argument is an empirical one: The Digital Flat Panel (DFP) Working Group chose TMDS and PanelLink for its connection and is shipping products that use the technology now. The DFP connection uses a simple 20-pin connector (instead of the 26-pin VESA P&D connector that is also designed to carry sound and USB data). That PanelLink cannot currently handle resolutions higher than SXGA is only a problem for workstation and high-end graphics card manufacturers, because the majority of PC users run their displays at SXGA or lower resolutions. Also significant is that there are no desktop products shipping yet based on a standard interface using LVDS.

If the major players in the DFP group follow the lead already established by ATI, Compaq, and Princeton, and we see the low-cost, high-quality graphics cards and monitors that are anticipated to appear between now and the end of the year, the DFP implementation of TMDS and PanelLink may gain an insurmountable lead in this market segment. The DFP group is submitting its design to VESA for approval as a standard, and if accepted, the race may be over before the other competitors are out of their starting blocks.—*AP*

terms of price and performance—and a harbinger of the heated competition that is likely to become even hotter in this market before the year ends.

STB Systems Inc.

STB Galileo 15

The STB Galileo 15, from STB Systems, is the Janus of the monitor world—being possibly the only product that can face two directions at the same time. Targeted at financial installations where users need access to a lot of information in a small space, the unit's $2,500 street price reflects its narrow market.

You get a lot for the price, however: Two 15-inch digital-interface LCD panels mounted on a single stand so that they can tilt and swivel independently, each with 1,024-by-768 resolution. Separate data cables (using PanelLink technology but with different connectors than the DFP standard) lead from the back of each panel to a single proprietary PCI graphics adapter. This adapter, the STB Symmetry, is outfitted with a pair of S3 Aurora 64+ graphics processors. Essentially, you get the equivalent of two 17-inch CRT displays with a smaller footprint than one CRT would require.

The panel has no physical controls, and the software contrast control appears to have more impact on brightness than contrast. In any event, the display was excellent for text applications—just as you might expect, considering its target audience. The black level was convincingly dark, and image contrast was excellent. The panels showed no signs of ghosting or streaking, and the pixel tracking and moiré patterns were rock steady without any jitter or drift. Nine-pixel text was crisp and clear.

These panels did have their weak points, however. They are only 16-bit panels, so they are not able to display more than 64 gray shades (and only 32 shades of red or blue). This resulted in banding on our color ramp tests and limited ability to produce very dark or very light shades of gray. As a result, this is not the display to pick for graphics applications.

There were some other minor flaws. The bottom and top edges were brighter than the rest of the image on both screens. There was also one small bright pixel defect on each panel. From a design standpoint, the fact that each panel has its own power supply and power cord seems somewhat clumsy and inconvenient; a single power cord and a single data cable would make desktop cable management easier.



STB Galileo 15
Street price: $2,500
STB Systems Inc., Richardson, TX; 888-478-2687, 972-234-8750
www.stbmvp.com
402 at www.pcmag.com/infolink.

The Galileo 15 comes with special software—called Mediator II—that treats the two panels as a single display. Using it, you can drag windows from one side to the other at will or zoom your application window to full screen so that your spreadsheets fill both panels. The one drawback is that STB only has Symmetry drivers for Windows NT 4.0; the display system is not yet available for Windows 95 or 98 installations.

The STB Galileo 15 is not for everyone, but it is well suited for its target market. If space is at a premium and you need access to enormous amounts of data from a Windows NT system, you may find yourself smiling into both faces of this unique display.

Toshiba America Information Systems

Toshiba TekBright 50D

The Toshiba TekBright 50D digital LCD desktop monitor is both good looking and clever. With an estimated street price of $1,600, the 1,024-by-768 resolution panel costs a bit more than its competitors but does something the other digital panels can't do: It rotates from landscape to portrait orientation. Price aside, this is the panel to beat.

The DFP connection was not defined when this product was developed, so Toshiba used PanelLink technology with its own connector and its own proprietary graphics adapter. According to Toshiba, there are plans to move to the 20-pin connector used by DFP products in the future to provide customers with a more flexible solution. The panel comes with a PCI graphics adapter driven by an S3 ViRGE/MX graphics processor.

The TekBright is simple and elegant. There's a power switch in the back, stereo speakers mounted in the feet of the stand, and a speaker-mute switch on one of the feet. There are also jacks for external speakers and a microphone if you want to use a headset, or you can just speak into the mike built into the panel's case. A brightness control on the side of the panel is, surprisingly enough, an old-fashioned analog thumbwheel. Just as surprising, this control is one of the easiest to adjust of all the panels we tested.

The image had remarkably uniform illumination, marred only by a slight splash of brightness along the bottom edge. Pixel tracking images are so steady, they look as if they were painted on, and there are no moiré patterns. Color tracking is excellent, with only the faintest ghosting in evidence. The biggest problem with the image quality is that color ramps fall off to black a bit abruptly at the low end, but this only affects images with faint details in deep shadow. Also, the panel does not scale up lower-resolution images well, displaying them in an unenlarged view—which is probably a better choice with this display.

The TekBright's rotation feature is especially handy for people working with desktop publishing or editing text. In portrait mode, you can view a full page at full scale. An icon in the tool tray on the Task Bar gives you quick access to either portrait or landscape mode. But be sure to change the orientation before you spin the display on its stand, because it's maddeningly difficult to run a mouse when all the movements are shifted by 90 degrees. Off-axis viewing is excellent in both planes, which is important given its two-way orientation.



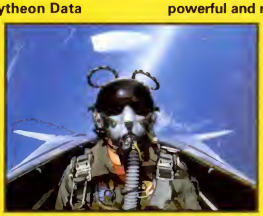
Toshiba TekBright 50D
Street price: $1,600
Toshiba America Information Systems, Irvine, CA; 800-867-4422, 949-583-3000;
www.toshiba.com
402 at www.pcmag.com/infolink.

Image quality alone makes this unit stand out in the crowd. If Toshiba brings out a newer version with a more competitive price and a connector that's usable with other manufacturer's graphics adapters, this unit will be that much more appealing. PC

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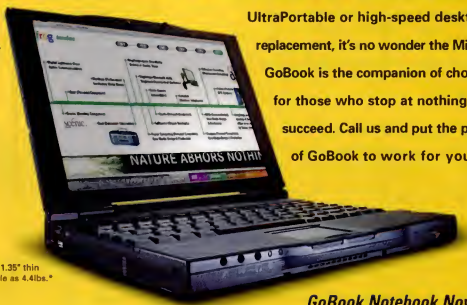
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INSPIRED DESIGN REQUIRES BOTH VISIONARY THINKING AND FLAWLESS EXECUTION. (TWO THINGS DOREEN LORENZO AND HER GOBOOK HAVE IN COMMON)



As president of frog New Media, Doreen Lorenzo is pioneering integrated strategic design and communications. Covering the spectrum from strategic planning and brand communications to product development and new media, frog has emerged as one of the clear leaders in the design industry. For over three decades and through hundreds of innovative design solutions for clients like Sony, Apple, and Disney, frog has perfectly blended a brilliant staff and the high-end equipment necessary to bring their ideas to life. Lorenzo and her GoBook™ are no exception. "There's just no way to take our clients global when I'm shackled to a desk," says Lorenzo. "And my GoBook gives me the mobility I need, without giving up power." With an innovative modular battery design and the versatility to play the role of either lightweight UltraPortable or high-speed desktop replacement, it's no wonder the Micron™ GoBook is the companion of choice for those who stop at nothing to succeed. Call us and put the power of GoBook to work for you.





Starts at just 1.35* thin
weighs as little as 4.4lbs.*

GoBook Notebook Now Features Fast Intel® Pentium® II Processors.

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- CNET *Editors' Choice, Best UltraPortable Reviewed, June '98*

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CNET Editors' Choice, Best UltraPortable Reviewed, June '98

Remember when you first heard about portable computers? You probably imagined an unbelievably powerful, incredibly light machine that lasted all day without being plugged in. A machine that would unshackle you from the office forever. So did our engineers. The experts and professionals who use them agree, with an innovative modular battery design, as little as 4.4* pounds in weight, and true desktop performance, nothing compares to the Micron GoBook.



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- 6.7lbs (w/opt./base battery & floppy)
- 512K L2 pipeline burst cache
- 12.1" SVGA display
- PCI bus with 128-bit graphics
- USB, parallel, serial, VGA, PS/2, NTSC/S-Video ports
- S-Video Out; MPEG compatible
- CardBus/Zoomed Video ready
- 16-bit stereo/Wavetable sound
- Microphone, stereo line-in/out jacks
- 24X modular CD-ROM drive
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- 2-way infrared port
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- Microsoft® Windows® 98
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- PCI bus with 128-bit graphics
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PEDIATRICIAN, DR. AMY ALCORN HAS DEVOTED HER LIFE TO SAVING CHILDREN. (SHE LEAVES SAVING TIME AND MONEY UP TO MICRON)



As the field of medicine continues to evolve at a rapid pace, a generation of physicians are turning to the latest technology to offer better patient care and management. Dr. Amy Alcorn is no exception. As a pediatric resident at the Texas Medical Center, one of the largest and most prestigious medical centers in the world, Amy routinely works over 100 hours a week in a variety of clinical patient settings. To organize her hectic work schedule and what little life she has outside of her job, Amy relies on her Micron™ TransPort Trek™. "If I need medical research, I can get it online virtually anywhere I am. So where I go, my Trek goes. It has become an indispensable part of my life." If you're in the market for a durable, reliable, and affordable desktop replacement notebook that can handle the rigors of any job you can throw at it, give us a call and let us show you what the Micron TransPort Trek can do for you.





"The TransPort Trek is the fastest budget notebook we've run through our mill."

- PC World, *Ranked #1, April '98*

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Those who use them and those who test them agree, Micron notebooks are among the best available. Practically every notebook line we've released has won the coveted *PC Magazine* *PC World*, "Best Buy," April & May '98 Editors' Choice award. And the TransPort Trek™ is no exception. Call Micron today and order any one of our award-winning notebooks custom configured to meet your specific needs.



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(Trek system featured in photo)

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STREAMING MEDIA

Getting Back in the Game

Who's on third? NetShow, with a big lead off the bag and threatening to tie the streaming-media game.

By Jan Ozer

Microsoft has been playing catch-up with RealNetworks in the streaming-media market since RealAudio shipped in 1994. Given RealNetworks' dominant market share and recent preview release of RealSystem G2 (see the sidebar) and its flashy next-generation technology, Microsoft needed a home run with its new version of NetShow to get back in the game.

Well, score a triple, as NetShow demonstrates significant advancements in all components while still being offered as a free upgrade to Windows NT Server 4.0. Even compared with G2, NetShow offers a high-quality streaming solution at a price that's impossible to beat.

But is Microsoft trying to eliminate the competition? RealNetworks has accused Microsoft of designing its Windows Media Player to disable G2, which Microsoft denies. Find out who's right in our Inside PC Labs online at *www.pcmag.com/pclabs/inside/in980727.htm.*

TECHNOLOGY COMPONENTS

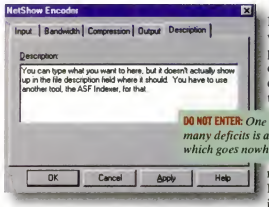
Like most streaming-media technologies, NetShow has three components: server, encoding tools, and player. We'll describe each in turn.

Because the server is a component of Windows NT Server 4.0, Microsoft now calls it Windows NT Server NetShow Services. As with previous versions, NetShow Services supports both live and on-demand distribution and includes controls over outbound streaming bandwidth, important for intranets.

NetShow Services' new features include *intelligent streaming,* which dynamically adjusts the media stream to optimize quality over changing line conditions. Also new are password protection and commerce-oriented features such as advertising insertion, which, like intelligent streaming, bring NetShow Services into parity with RealVideo 5.0.

NetShow Services raises the bar with branding opportunities like video watermarks, an advertising banner bar, and a display bar, which display on the new player (described below); all are configurable for messages and customer hyperlinks. In addition, server functionality is more integrated with other Windows NT services. For example, streaming-media statistics are included in Site Server usage reports, and advertising insertion is integrated with the Site Server Ad server.

Although RealNetworks offers a free server for small Internet sites, you 'll need to purchase a server for intranets or for access to many of the features described above. This gives NetShow an advantage with those sites desiring more than basic functionality.



DO NOT ENTER: *One of NetShow Encoder's many deficits is a description field, which goes nowhere.*

WEAK ENCODING TOOLS

The NetShow encoding toolset is the weakest link in the product offering. Though NetShow Encoder works acceptably well when using presets, it's tough to customize, and the product changes critical quality-related and design-oriented file characteristics without warning.

In addition, you can't insert clip, author, and copyright information in the Encoder. You have to use another program, Microsoft's ASF Indexer. You use yet another program (Digital Renaissance's T.A.G. Author) to create the required HTML files. By contrast, the competing RealPublisher performs all three functions in one simple interface.

Although the NetShow Premiere plug-in performs well, it works only with presets. This means you can't manually adjust any encoding parameters, so the plug-in is useless for many developers. RealNetworks' Premiere plug-in is fully functional.

Similarly, the PowerPoint plug-in, designed for live presentations, doesn't recognize audio inserted into PowerPoint documents. There is a tortuous workaround, but RealNetworks' plug-in is much easier for canned presentations (though it doesn't enable live presentations).

One bright spot is the included T.A.G. Author, which synchronizes still images and audio and inserts markers, captions, and scripts. Still, Microsoft's tools make up an unfortunate hodgepodge; they get the job done but are at a significant competitive disadvantage when compared with RealNetworks.

STRONG QUALITY

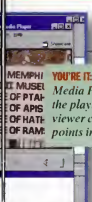
Fortunately, the picture brightens considerably for quality comparisons, even with RealNetworks' new technology RealSystem G2. For example, in high-motion 320-by-240 resolution videos, at both 50 Kbps and 100 Kbps, NetShow won all benchmark tests. In talking-head video comparisons, NetShow played much more smoothly than G2, though exhibiting a touch more blockiness and "mosquito" artifacting, probably as a result of the higher playback frame rate.

On the audio front, the technologies were extremely close. For our speech-only clip, NetShow was slightly clearer, with no warbling. This advantage held in our speech-with-music background clip, with which NetShow produced slightly less echoing and distortion. Music tests were a draw.

G2 is still under development, and RealNetworks will likely draw out more quality from both audio and video codecs before shipment. But with NetShow Services, Microsoft has reversed RealNetworks' historical superiority in both video and audio quality, eliminating a significant competitive disadvantage.

MEDIA PLAYER REDUX

Rather than updating its NetShow 2.0 Player, Microsoft integrated streaming-media playback into a free upgraded Windows Media Player. The new program—which runs on Windows 3.x, 95, and NT; Power Mac; and several Unix flavors—plays nearly every multimedia format, including RealVideo, MPEG-1 and MPEG-2, QuickTime,



YOU'RE IT: *T.A.G. Author and the new Media Player. The text descriptions under the playback window are markers the viewer can use to link directly to specific points in the video file.*

AVI, WAV, MOV, and many others.

In addition to the branding described above, the new player automatically seeks and downloads new codecs as needed, simplifying user configuration. The player also supports closed-caption text playback and lets users drag and drop files from the player onto their desktops. They can also select favorites for easy repeat playback.

Scheduled to ship by the end of 1998, RealSystem G2 will undoubtedly play well in the broadcast and advertising communities. But intranets and large Web sites that are seeking simple audio and video playback will find NetShow's media quality and free price tag extremely alluring.

Microsoft Windows NT Server NetShow Services. List price: Free. Requires: For server: 48MB RAM (32MB for Alpha), 21MB hard disk space, Microsoft Windows NT Server 4.0 with Service Pack 3.0 or higher. For tools: 16MB RAM, 21MB hard disk space, Windows 95. For client: 8MB RAM, 6–11MB hard disk space, Windows 95 or NT. Microsoft Corp., Redmond, WA; 800-426-9400; www.microsoft.com. *419 at www.pcmag.com/infolink.*

A Quick Reality Check

The beta release of RealNetworks' RealSystem G2 debuts intriguing new formats that help all Web sites deliver higher-quality multimedia experiences at 28.8 and 56 Kbps. G2 also includes improved audio and video codecs and low-level architectural changes that enhance the end-user experience and simplify development. This makes G2 a natural for Internet broadcasters and high-volume Web sites, though low-volume sites using just audio and video should consider Microsoft's free NetShow Services.

The most striking additions in G2 are two new formats, RealPix and RealText, and support for the Synchronized Multimedia Integration Language (SMIL), a proposed World Wide Web Consortium (W3C) standard. Briefly, SMIL integrates audio, video, text, animation, and still images into a synchronized stream with transitions and other effects, along with hyperlink capabilities for most assets.

SMIL changes the fixed-video-window paradigm into a flexible presentation palette containing multiple media. For example, CNNiN is broadcasting a 320-by-240 resolution presentation containing a 176-by-132 video feed, headlines that link to other stories, and a link to its home page. A live stock ticker can also easily be integrated into the feed.

The key benefit is the enhancement of presentations in both appearance and functionality, with minimal additional bandwidth requirements. Also, because images are maintained as separate JPEG files, transitions can be applied by the player, again enhancing presentation appearance at minimal bandwidth cost.

SMIL's key challenge is creating an authoring environment that supports its robust feature set. In the beta release, RealNetworks' SMIL Presentation Wizard shows promise but still requires hand-coding of SMIL script files. We used Digital Renaissance's T.A.G. Editor on our tests to good effect, however. And other vendors, like Sausage Software and Allair, promise to ship SMIL-creation tools at or near G2's final ship date in late 1998.

G2's most significant architectural enhancement is Stream Smart, a technology that lets one file serve multiple connection speeds. With Stream Smart, the G2 server uses one media file and automatically customizes the stream for the remote client's connection speed. Stream Smart also dynamically adjusts the data flow to changing line conditions, optimizing the user experience.

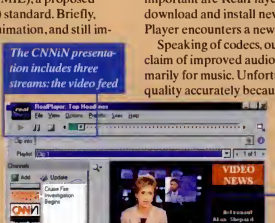
On the user front, the G2 RealPlayer provides one-button access to content from a wide range of media sites, with broadcast headlines appearing in a contents panel. More important are RealPlayer's auto-update capabilities that can download and install new codecs automatically when the Player encounters a new format.

Speaking of codecs, our tests verified RealNetworks' claim of improved audio quality over RealSystem 5.0, primarily for music. Unfortunately, we couldn't test video quality accurately because the beta encoder didn't provide access to the precise controls needed for our tests. In general, however, our tests showed audio and video quality to be roughly comparable to that of NetShow.

G2 makes streaming media much more meaningful to the millions of 28.8- and 56-Kbps clients that dominate most Internet traffic. On the other hand, if your needs encompass only low-volume audio and video, Microsoft's equivalent quality and free price make NetShow Services a logical first stop.—*J.O.*

RealSystem G2 (beta). Price: Encoder and player, free download; 25-stream Internet servers, free; intranet servers, starting at $5,000 for 100 seats; Internet servers, starting at $6,000 for 100 streams. Requires: Encoder, 8MB RAM, 7MB hard disk space, Microsoft Windows 95. Player: 16MB RAM, 4MB hard disk space, Microsoft Windows 95. RealNetworks Inc., Seattle; 206-674-2700; www.real.com. *420 at www.pcmag.com/infolink.*

The CNNiN presentation includes three streams: the video feed



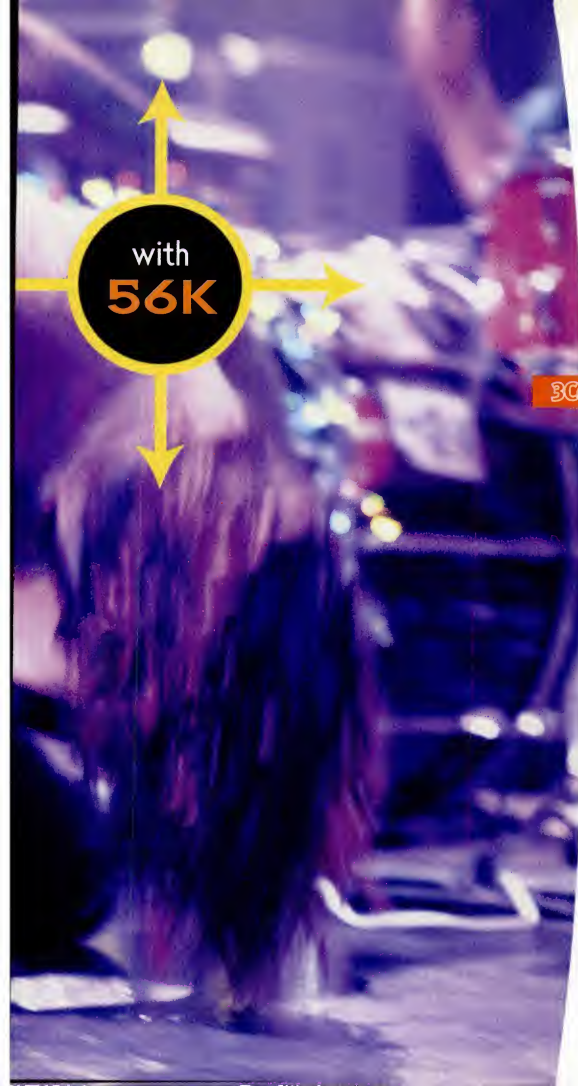
and text streams, which link to detailed multimedia stories.

the logo, which links to the company's Web site



*Capable of receiving samples at up to 56 Kbps and sending at up to 31.2 Kbps. Due to FCC regulations, receiving speeds are limited to 53 Kbps. Actual speeds may vary. Requires compatible phone line and server equipment. Consumers with both the determined V.90 56K standard and x2™ technology. Ratification expected September 1998. See your 3Com Corporation for details.

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NOTEBOOK PCs

Four Pounds, Pentium II

Toshiba's new Portégé 7000 is the ultimate ultraportable for power-starved road warriors.

By Carol Venezia

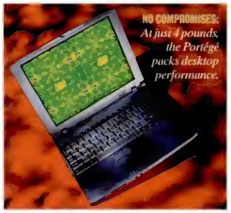
If you think you can't buy a notebook PC that performs better than a similarly equipped desktop but doesn't weigh 10 pounds, guess what: You're finally wrong! With Toshiba's new 266-MHz Pentium II–powered Portégé 7000 ($3,000 street), you get Windows applications performance that matches same-speed desktops, and you'll weigh yourself down by only a scant 4 pounds.

Outfitted in a sleek new silver-and-gray chassis, the Portégé 7000 measures just over 1 inch thick, 11.5 inches wide, and about 9.5 inches deep, with a 2,500-mAh lithium battery installed. It's actually a bit thinner and lighter than IBM's popular ThinkPad 560 but has a more powerful CPU (the 560's fastest is a 233-MHz Pentium MMX) and a higher maximum RAM capacity (160MB of synchronous DRAM versus the 560's 96MB of EDO).

The Portégé also has an integrated V.90-ready K56flex modem (which supports DSVD using V.34 and V.80); the ThinkPad 560 must rely on PC Card modems. But IBM's ultraportable gives you longer battery life: In our August 1998 portables roundup, a 560X clocked about 4 hours on our ZD Battery-Mark 2.0 test; the Portégé lasted 2 hours 36 minutes.

The area in which this notebook really shines, however, is performance. The Portégé produced a Winstone score of 20.3, which is on a par with the crop of 266-MHz PII desktops just tested for our most recent PC roundup (see our issue of September 1, 1998). Its Graphics WinMark score was also stellar at 127, which ties those posted by the top-performing notebooks in our August roundup.

Like other ultraportables, the Portégé 7000 keeps its svelte physique by using an outboard floppy disk drive—in this case, a thin, 8-ounce device. It also goes



light on integrated ports, with just SVGA-out and USB on board. If you want more, hook up the included 8-ounce port expander, which adds parallel, serial, and keyboard/mouse ports. The notebook also incorporates two stacked Type II PC Card slots and a fast infrared transceiver, as well as headphone and microphone jacks.

Flip open the lid, and inside you'll find a 12.1-inch SVGA active-matrix display, a full-size keyboard, and Toshiba's familiar green AccuPoint pointing stick. Mouse buttons are correctly positioned slightly left of center on the unit's expansive palm rest. One component that's changed from previous models is the AC adapter brick. It's about double the size and weight of the Portégé 320, so it adds nearly a pound to the unit's travel weight.

Toshiba has some great add-ons for this notebook. You can get a high-capacity battery ($190 street) and a CD-ROM Network Dock ($650 street). The latter device is about 0.75-inch thick, snaps on to the bottom of the notebook, and adds a CD-ROM drive, a Fast Ethernet adapter, stereo speakers, and a floppy disk drive. The unit has two USB ports, as well as serial, parallel, keyboard, mouse, and video-out ports. It also has line-in, line-out, headphone, and microphone jacks.

Corporate buyers will be pleased to find out that the Portégé 7000 is a highly manageable system. It comes preloaded with Intel's LANDesk Client Manager, Version 3.2, has a DMI 2.0–compliant BIOS, and complies with Version 1.0 of the ACPI specification. Toshiba also provides a three-year warranty, with worldwide service.

With the Portégé 7000, traveling light no longer means compromising on performance.

Toshiba Portégé 7000. Street price: $3,000, with a 266-MHz Pentium II CPU, 32MB SDRAM, a 3.9GB UltraDMA hard disk, and a 12.1-inch SVGA display. Toshiba America Information Systems Inc., Irvine, CA; 800-867-4222; www.toshiba.com. *418 at www.pcmag.com/infolink.*

Hard Copy on Location

The new Canon BJC-50 portable ink jet printer ($350 street) is smaller, lighter, and faster than the two-time Editors' Choice–winning Canon BJC-70. The BJC-50 includes lithium ion batteries good for printing 100 pages and a 115Kbps infrared interface. Although the BJC-50 lacks the earlier models' standard 30-page sheet feeder (now a $60 option), improved portability features make the BJC-50 a great choice for road warriors.



At just 1.9 x 11.8 x 4.4 inches (HWD), the BJC-50 will fit easily in most briefcases along with a notebook computer. The printer weighs just 2.9 pounds with battery, ink cartridges, and AC adapter.

The four-color BJC-50 Canon Bubble Jet printer is rated at up to 5.5 ppm in black text and 2 ppm printing color. The maximum 720-by-360 dpi is unchanged from the BJC-80, but the new printer's Drop Modulation Technology creates full- and half-size drops, which aids in printing smooth color transitions and photo images. In testing, the BJC-50 did a good job with standard tasks, though images from a megapixel digital camera were somewhat grainy.

The BJC-50's optional ($100 street) IS-12 scanner head replaces the printer cartridge with a 360-dpi 24-color scanner that accepts documents up to 8.2 by 11.5 inches.

The Canon BJC-50 continues the printer line's tradition of good quality portable color printing, with added scanning capability, smaller size, and less weight.

—Bruce Brown

Canon BJC-50. Street price: $350. Requires: 8MB RAM, 50MB hard disk space, Microsoft Windows 3.1 or 95. Canon Computer Systems Inc., Costa Mesa, CA; 800-652-2666; www.ccsi.canon.com. *417 at www.pcmag.com/infolink.*

PHOTOGRAPHY BY THOM O'CONNOR

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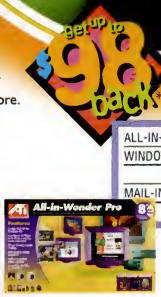
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DIGITAL CAMERAS

Capture Control

Nikon's Coolpix 900 digital camera is packed with advanced features.

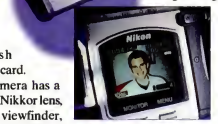
By Bruce Brown

Targeted at the avid amateur photography market, the Nikon Coolpix 900 digital camera ($900 street) has a raft of features for controlling image capture. In addition to the maximum 1,280-by-960 resolution mode (rated for printing images up to 8 by 10 inches), the Nikon has advanced exposure and metering control, five flash modes, and 945-step automatic focusing.

The 20-ounce (including four double-A batteries) Coolpix 900 measures 3 by 6.2 by 1.4 inches (HWD). Standard accessories include serial cables for PC and Mac connections, NTSC video display cable, and a 4MB CompactFlash memory card.

The camera has a 3x Zoom-Nikkor lens, optical viewfinder, and a 2-inch LCD for color image composition and review. A second, monochrome LCD displays battery status, remaining exposures, flash and focus settings, self-time indicator, image quality, metering and drive settings, plus exposure and brightness icons.

The lens and LCD sections of the camera rotate, letting you take pictures from any angle. With the standard lens, the camera will focus as close as three inches in macro mode. The wide-angle lens adapter decreases the minimum focal length range to 24mm to 72mm (in 35-mm camera equivalents).



CLOSE-UP: *The Nikon's LCD swivels for self-portraits.*

Two capture modes are available: manual or automatic. Automatic mode lets the user control flash, zoom, and image quality. In manual mode, you control all settings, including focus. Advanced manual settings include three light metering modes (spot, center-weight, and matrix) and white balance settings for indoor, outdoor, day, and night lighting. Drive settings range from normal single frame to VGA sequence (in which ten frames are taken at two frames per second each time the shutter is pressed).

Playback mode allows you to view stored images on the LCD screen or, when connected by cable, on a television or video monitor. Playback has single, selected, or all-image deletion options (with settings to hide and protect images from deletion), and a slideshow feature.

Image capture with the Nikon displayed little of the delay so noticeable with many digital cameras. Image focus quality and color are good, with particularly impressive results with the wide-angle adapter in full-zoom macro mode.

Compact but loaded with features, the Coolpix 900 is a good choice for variety of applications. **Nikon Coolpix 900.** Street price: $900. Requires: Microsoft Windows 95 or NT 4.0. Nikon Inc., Melville, NY; 800-526-4566, 516-547-4355; www.nikonusa.com. *415 at www.pcmag.com/infolink.*

APPLICATION DISTRIBUTION

Push Apps with Castanet

Marimba's Castanet helps network administrators remotely install and manage software applications.

By Robert P. Lipschutz

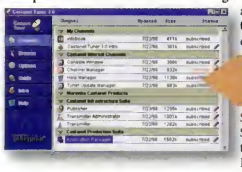
Castanet addresses one of the classic time wasters in network management—software installation and updates. Version 3.0 adds improved application-packaging support and a new management suite for managing and monitoring the Castanet product suite.

By using an application resident on each desktop, Castanet can automatically install and update both off-the-shelf applications, such as Microsoft Word, and custom applications. Administrators package the applications remotely for delivery to users. Network administrators must decide which options will be installed for each application, which may annoy some end users.

Everything in Castanet revolves around channels. The Tuner (a Windows applications residing on each desktop) subscribes to channels made available by a Transmitter. A channel will typically contain a single application, such as a custom Java application. Once the Tuner is pointing to the correct channels, installing or obtaining the latest version of an application is done automatically. (Castanet doesn't address the issue of software licensing.)

Castanet products are dispersed in three product suites: the Infrastructure Suite contains the Tuner and Transmitter, the Production suite contains tools to ready applications for use with Castanet channels, and the Management Suite has tools for managing and monitoring Castanet products.

On the back end, an administrator uses the Production suite to prepare applications. The packaging process relies on the fact that the result of an application installation is simply a set of directories, files, and registry changes. By taking an initial snapshot of the computer, installing the application, and taking another snapshot, the Packager determines exactly what has changed. These changes are published to a channel on the Transmitter. The user never sees the installation process.



Administrators will need to package applications separately for Windows NT and Windows 95 users since they may have different registry changes, but Castanet provides a way to hide this complexity from the users. By using what are called segments, all users subscribe to the same channel, and the Castanet tuner automatically distinguishes between Windows 95 and NT.

Castanet is best at handling homogeneous environments in which each application uses the same settings. But if sharing CD-ROMs hasn't solved your problems, the Castanet family is an ingenious way of centrally managing desktop applications. **Castanet 3.0.** List price: Production Suite starts at $10,000; Management Suite: $15,000; Infrastructure Suite: $50 per seat. Requires: 16MB RAM, 14MB hard disk space (32MB RAM and 29MB hard disk space for Sun Solaris), Microsoft Windows 95, 98, or NT 4.0, Solaris 2.5.1/2.6. Marimba Inc., Mountain View, CA; 650-930-5282, 888-930-5282; www.marimba.com. *416 at www.pcmag.com/infolink.*

UPGRADE: *The Tuner subscribes to channels that house applications.*

PHOTOGRAPHY BY THOM O'CONNOR

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THe CIO IS iN THE hot seat as the executive committee drills one department head after another on escalating costs. How are you going to [1](get the newly acquired subsidiary onto our e-mail system)? How are you going to [2](hold down your network administration head count) as you add hundreds of new users? How can you afford to [3](roll out new apps to the whole company)? It's like the Spanish Inquisition, but the food is worse. Her stomach rumbles from the dry turkey sandwich and yuppie water served at the start of the meeting as one committee member wakes up long enough to ask about the [4](Year 2000 problem) he saw on a CNN segment. "Not a problem, we have it covered," she replies. With an unforeseen compliment for completing the [5](global supplier extranet) project, she is excused. Exiting, she smiles at the beleaguered marketing director, who is about to be skewered because the company's celebrity pitchman has just appeared on the cover of a supermarket tabloid.

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HAND-HELD COMPUTING

Power to the Pilot

The Synapse Pager Card give your old Palm device messaging features and Palm III power.

By Bruce Brown

If you're a Pilot or PalmPilot owner, you can have all of the Palm III features (except the infrared transceiver), plus one-way alphanumeric paging and voice mail by adding the Synapse Pager Card ($170 street, plus $19.95 monthly for nationwide roaming). The Synapse card, manufactured by Motorola, uses one-way Flex paging technology.

Compatible with all Palm models except the Palm III, the Synapse card replaces the existing memory card—and the handy Graffiti alphabet reference—in your Palm device. The card provides an upgrade to 2MB of FlashRAM, the new Palm 3.0 operating system, support for additional fonts, 3Com's Palm Desktop Organizer software, and file-linking synchronization.



The Synapse pager service, provided by PageMart Wireless, processes personal messages and sends you AP News updates, with sports and weather reports. Fourteen additional information services are available as options.

A visual and/or audible alert is activated when you receive a message, even if your PDA is turned off. Up to 32 sequentially numbered incoming messages of up to 300 characters can be stored in your PDA. If your Palm device can't receive a message (if you're in flight, for example), you can retrieve them by phone from PageMart, where the messages are stored for 15 days.

You can also receive wireless messages sent to your Palm device via your pager e-mail address or PageMart's Web site from those who know your PIN number. The Sender ID feature will display the person's name if the sender is listed in your PalmPilot Address Book.

The Synapse card lets you save messages in categories, copy and paste message contents into other Palm applications, and perform keyword searches across messages. A Wireless Schedule update feature lets you update your appointments through a dedicated PageMart Web site.

The voice mail service provided with the Synapse package sends a message alert to the pager. You retrieve messages by calling a toll number service; toll-free access is an additional cost.

Before you replace your existing Palm device with a new Palm III or buy 3Com's upgrade option, check out the feature-rich Synapse Pager Card. It may be a better fit for your PIM and wireless communication needs.

Synapse Pager Card. Street price: $170, plus $19.95 per month for nationwide roaming. Requires: IBM WorkPad PC Companion, PalmPilot Personal, PalmPilot Professional, Pilot 5000, or 3Com Pilot 1000. PageMart Wireless, Dallas; 888-318-2010; www.pagemart.com. *410 at www.pcmag.com/infolink.*

INTERNET COMMUNITY HOSTING

Howdy, Web Neighbor

Host, create, and manage your own online community with PowWow's easy-to-use software.

By Greg Alwang

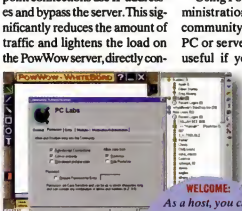
PowWow 3.6, from Tribal Voice, is on the path to bringing online community hosting to the masses. Available as a free download, PowWow builds virtual communities with support for text and voice chat, point-to-multipoint communications, bulletin boards, Web tours, and file transfers.

New to this version is the option to create and host your own community ($49.95 per year for up to ten simultaneous users). PowWow is ideal for existing Web-savvy groups or small communities that need to communicate in an environment where they control the participants.

All user and community administration features are integrated into the intuitive PowWow Navigator window. From here, you join communities, send instant voice and text messages, and manage your Buddy list. The Personal Communicator window lets you chat privately with up to eight users, conduct real-time voice conversations, play sound files, use the white board, and play built-in games.

You search for PowWow users and communities using the On-Line White Pages and the Community Guide. A Community Chat window gives you access to ongoing conversations, a guest book, and the bulletin board. A rudimentary built-in voice synthesizer lets you hear users in a chat room.

PowWow excels not only in breadth of features but also in performance. Unlike similar products such as AOL Instant Messenger and ICQ, which periodically connect to the server, creating excess traffic, PowWow connects only when you sign on and when there are updates to your Buddy list. All point-to-point connections use IP addresses and bypass the server. This significantly reduces the amount of traffic and lightens the load on the PowWow server, directly contributing to PowWow's speed. This lightweight, distributed architecture also lets PowWow scale up to support large communities.



WELCOME: *As a host, you can control all aspects of your community—from customizing welcome messages to designating moderators and disconnecting profane users.*

You can host a community on any Windows 95 or NT PC with an Internet connection. You not only control which options are available to visitors but also specify the members of the community, set the access levels, turn on profanity filtering, and designate discussion moderators.

Using PowWow's remote administration, you can host a community on someone else's PC or server. This is especially useful if you want to host a round-the-clock community but lack the resources to do so. Other high-end features, such as automatically disconnecting profane users, give you ultimate control over your personal community. **PowWow 3.6.** Direct price: $49.95 per year to host a ten-user community. Requires: 9,600 bps or faster Internet connection, Microsoft Windows 95 or Windows NT 4.0 or later. Tribal Voice, Scotts Valley, CA; 877-476-9969, 408-461-3100; www.tribal.com. *411 at www.pcmag.com/infolink.*

PHOTOGRAPHY BY THOM O'CONNOR

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NETWORK WORLD MAGAZINE'S WORLD CLASS AWARD



When *Network World*[1] magazine gave the 400MHz dual-processor PowerEdge® 2300 server[11] their World Class Award, they rated it "... first in overall score, thanks to its strong showing in serviceability, features, flexibility and manageability." That's because the PowerEdge 2300 takes the anxiety out of the occasional upgrade or servicing issue. Need to install a card or add a drive? No tools necessary — hot swap bays, thumbscrews and flip tabs let you get in, handle it and get out with only your bare hands. Want performance? How about up to two screaming-fast Pentium® II processors at 400MHz, 100MHz ECC SDRAM, and up to six Ultra-2/LVD SCSI hot-swap hard drives. In short, you'll have a server you can rely on, a server that can grow and adapt with your business. A "World Class" server. For more information on the PowerEdge 2300, just give us a call or visit www.dell.com — possibly the easiest decision you can make.

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intel inside
pentium II

[11]Award-winning configuration included 400MHz duel processors, 128MB 100MHz SDRAM, 4 hard drives and RAID.

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JAVA DEVELOPMENT TOOLS

A Common Language

With new server- and client-side features, JBuilder 2 is a tool to watch for the cross-platform Java market.

By Richard V. Dragan

Inprise Corp. (formerly Borland International) has enhanced JBuilder 2 Client/Server Suite ($2,495 list) with unprecedented support for database and enterprise features. This new version also establishes a strong commitment to using 100 percent pure Java development and JavaBeans.

JBuilder 2's Integrated Development Environment's (IDE) familiar look and feel is based on Inprise's other RAD tools, such as Delphi. As with the other products, the emphasis is on component programming, in which properties are set visually and wizards help you write code.

IT'S IN THE BEANS

With over 200 JavaBean components, the palette in JBuilder 2 is particularly rich. The JavaBeans range from basic UI elements to more advanced controls like grids and tables. There's also full support for the new JFC/Swing classes and an extensive array of database-aware components to show live data through JDBC.

JBuilder 2 also bundles JavaBeans from several leading Java component vendors, including KL Group, Object FX, Protoview, and Roguewave. With this selection of components, Java interfaces can be just as sophisticated as those created for native operating systems using C++ or Delphi.

We were impressed by JBuilder 2's true two-way Java code editing. Changes to the source code are propagated to the visual design (and vice-versa) without any hidden sections of code or markers, as is the case with other Java tools. Such code intelligence is included in the product in several other areas, such as the new Code Insight feature, which provides context-sensitive pop-up help for writing methods with the proper arguments automatically.

RETOOLED

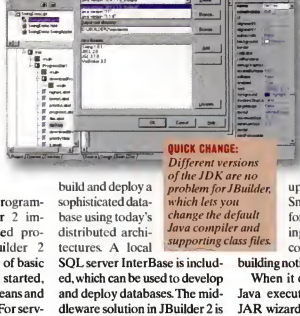
In addition to basic programming smarts, JBuilder 2 improves its wizard-based programming tools. JBuilder 2 supports a wider range of basic target types to get you started, including custom JavaBeans and Enterprise JavaBeans. For server-side development, JBuilder 2 now supports Java servlets, as well as CORBA for distributed systems. To simplify creating custom beans, the BeansExpress tool now can add properties and methods to JavaBeans automatically.



JGUI: *Build sophisticated user interfaces with over 200 built-in JavaBeans in JBuilder 2, including full support for the new JFC/Swing classes.*

The main focus of the JBuilder 2 Client/Server Suite is on enterprise development and deployment. The wizards for creating database applications in JBuilder 2 offer a high degree of ease of use without coding. On our tests, we easily built a data-aware form using the powerful visual query designer.

JBuilder 2's tools offer just about everything you'd need to build and deploy a sophisticated database using today's distributed architectures. A local SQL server InterBase is included, which can be used to develop and deploy databases. The middleware solution in JBuilder 2 is the Borland DataGateway for Java, which allows client-side Java apps to connect to databases using pure Java JDBC drivers.



QUICK CHANGE: *Different versions of the JDK are no problem for JBuilder, which lets you change the default Java compiler and supporting class files.*

For distributed computing and CORBA, JBuilder 2 bundles the VisiBroker for Java 3.2, an object-request broker. With the built-in wizards and compiler support, even fledgling programmers can call remote methods using RMI and CORBA/IIOP. (The compiler takes care of creating the Java bindings for distributed calls.)

One of JBuilder 2's strongest features is its open architecture, which allows for switchable JDKs. We were able to swap the versions of the JDK (from 1.0.2 to 1.2) used to build a test Java application. JBuilder 2's highly extensible environment makes it possible to cope with the babble of today's different versions of the Java Virtual Machine (JVM). This configurability also opens the possibility of adding JAR and CLASS files to any JBuilder 2 project more easily than with other Java tools.

DEBUG AND DEPLOY

JBuilder 2 has all the usual debugging features, including watches, breakpoints, and pop-up inspection windows. Although JBuilder 2 doesn't support an instant update feature, its SmartChecker feature for dependency checking and its improved compiler makes rebuilding noticeably snappy.

When it comes to deploying Java executables, JBuilder 2's JAR wizard works for creating redistributable JAR files. Another winning feature is the Inprise Java Deployment Server—a server-side program that can automate the installation of JVM as well as your application files on client machines.

With its enterprise focus and good target flexibility, JBuilder 2 may well help realize the cross-platform vision of Java. Whereas other vendors are working to bring Java into the Windows fold, Inprise's JBuilder 2 stresses an open platform approach that will make the software an attractive solution to many large organizations that need to run Java programs on different types of hardware.

JBuilder 2 Client/Server Suite. List price: $2,495 ($1,995, upgrade). Requires: 48MB RAM, 135MB hard disk space, Microsoft Windows 95 or NT 4.0. Inprise Corp., Scotts Valley, CA; 800-233-2444, 831-431-1000; www.inprise.com. *407 at www.pcmag.com/infolink.*

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DOCUMENT MANAGEMENT SOFTWARE

Organize the Chaos

PageKeeper Standard 3.0 offers an inexpensive, simple way to add some order to your electronic paperwork.

By David Haskin

With scanner prices plummeting and Web content expanding, many people need help managing the flood of information. PageKeeper Standard 3.0 ($40 street), newly redesigned to resemble competing document managers such as ScanSoft's Pagis Pro and Visioneer's PaperPort Deluxe, is a simple solution to this complex problem.

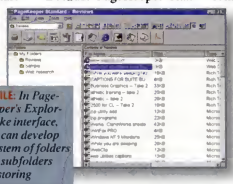
Like its competition, PageKeeper has a Windows Explorer–like interface that displays user-created folders in the left pane and the contents of folders in the right. You place items in PageKeeper folders by scanning documents or adding files from your hard disk or pages from the Web. This last capability makes PageKeeper a good tool for collecting and managing information mined from the Web, although the software can't automatically add the page currently in your Web browser; instead, you have to type the URL.

Unlike PaperPort Deluxe, which imports documents into a proprietary database, PageKeeper keeps them in their original file formats and locations on your PC. PageKeeper automatically creates a small control file for each document you add that contains the file's location, any text within the file, and keywords you optionally include. The software then automatically updates the control file if you delete, move, or change the source file.

You view information either with PageKeeper's built-in viewer or by clicking a toolbar button to load the document and the application associated with it. You can search from within PageKeeper or with a dialog box placed by PageKeeper in the Find submenu of the Start menu. Searches can look for text contents of files, keywords, or file names.

PageKeeper Standard 3.0 is easy to use, but it's less powerful than its competitors. The program doesn't support Boolean searches or rank results by relevancy, for example. In addition, PageKeeper doesn't index documents, but rather searches sequentially through all the words in the documents, a comparatively slow process. For instance, a search of 80 Microsoft Word documents took about 6 seconds, and a search on the same word in about 1,000 files indexed by Pagis Pro required just 4 seconds.

Because PageKeeper Standard 3.0 requires more time to search as the number of documents increases, it's unsuitable for managing large numbers of documents. But PageKeeper's approach may be preferable for small numbers of documents, because it creates and updates control files almost instantaneously (updating an index can bog down your computer).



ON FILE: *In PageKeeper's Explorer-like interface, you can develop a system of folders and subfolders for storing documents.*

PageKeeper Standard 3.0 isn't as powerful as similar programs, but it is an inexpensive and convenient way to gain control of your documents.

PageKeeper Standard 3.0. Street price: $40. Requires: 16MB RAM, 35MB hard disk space, Microsoft Windows 95, 98, or NT 4.0. Caere Corp., Los Gatos, CA; 888-922-2373, 408-395-7000; www.caere.com. *409 at www.pcmag.com/infolink.*

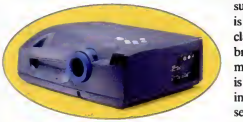
LCD PROJECTORS

XGA, Here or There

In the conference room or on the road, the Lightware L-1020 LCD projector will make your point.

By Alfred Poor

Lightware made a big splash with a tiny LCD projector when it introduced the VP100 more than two years ago, establishing the under-10-pound segment of this market. The new $9,995 (list) L-1020 is a departure from the original design, and at 13 pounds, this XGA-resolution projector is targeted at both portable and conference-room applications. The new design has some small flaws but should be a strong competitor in its market.



SHOWTIME: *The L-1020 tested at 523 lumens.*

Setting up the L-1020 is easy, with manual zoom and focus providing a good range of control. The onscreen menus could be easier to understand, but for the most part you won't need the manual.

The projector is rated at 700 ANSI lumens, and our tests measured 523 lumens, which is about average for this class of projector. The brightness uniformity measure was 1.3, which is also about average and in keeping with the observation that the screen was slightly brighter in the center than in the corners. The contrast ratio of 109:1 is also about average.

Our evaluation model froze in testing and had to be unplugged to reset it. This problem in the early production projectors was solved for subsequent units. And since the projector's controller can be upgraded with software, units can be fixed by downloading a patch file to the projector. This is done with a free serial communications program that also lets you control the projector from your computer (in addition to the remote control and front-panel buttons).

The projector did show some image flaws; some test images showed strong pixel jitter effects, which could not be reduced through the use of the frequency or tracking controls. These effects were so pronounced that evaluating the focus patterns was difficult. Otherwise, the data image quality was excellent.

The L-1020 did a good job with video images, though the sound system was easily powered past the point of distortion, and the tone controls were limited. There were no obvious motion artifacts in the images, but facial tones did show some signs of being mottled.

A compact design, brightness, and software-upgrade feature along with a bundled carrying case make the L-1020 attractive. But the image quality flaws put a little tarnish on the shine.

Lightware L-1020. List price: $9,995. Lightware Inc., Beaverton, OR; 800-445-9396, 503-641-7873; www.lightware.com. *408 at www.pcmag.com/infolink.*

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PERIPHERALS

DV for the Masses

Canon's affordable ZR camcorder brings high-quality digital video to the mainstream market.

By Jan Ozer

With a street price of $1,400, Canon's ZR digital video (DV) camcorder is within the price range of some analog camcorders, but it delivers better-quality video and a richer feature set. Combine this with a modular, compact design and DV FireWire output, and you've got an ideal camera for consumers and low-end multimedia applications.

CONVENIENT OPERATION

The ZR is shaped and held like a compact 35mm camera and fits in a suit pocket or purse. You view and replay through a 2.5-inch LCD panel and shoot using controls located by your right index finger. A small mesh-covered microphone on top of the unit captures audio, with an on-board speaker for playback.

Zoom controls are conveniently located by your right thumb, with intuitive playback controls by your left index finger. The LCD panel swings up 180 degrees, allowing subjects to view their own video feed; you can also convert the LCD to a viewfinder with a supplied attachment.

Ports on the camera include DV-out and a headphone jack, with a supplied docking unit providing stereo audio and S-Video and composite video outputs, along with microphone input and a LANC connector. Other components that are included with the ZR are an AC power adapter and battery charger, a lithium ion battery with a 50-minute recording capacity and 90-minute recharge time, a remote-control unit, S-Video, composite and stereo audio cables, a shoulder strap, and a 30-minute MiniDV cassette.

STRONG FEATURE SET

For a consumer-oriented camcorder, the ZR is full-featured and highly programmable. The camera has an 11X optical zoom and 44X digital zoom, automatic image stabilization, a shutter speed of up to 1/8,000 second, plus/minus 11 EV exposure compensation, and a minimum shooting distance of 3/8 inch.

The camera can operate fully automatically, or you can set focus, exposure, shutter speed, and white balance manually. The ZR also has five programmed modes—sports, portrait, spotlight, sand and snow, and low light—with controls optimized for each condition.



The ZR ships with seven digital effects—three to begin or end a scene (fade, wipe, and scroll) and four to use throughout a clip (solarization, black and white, sepia, and strobe). Other options include 16:9 recording mode for playback on wide-screen TVs, 12- or 16-bit audio capture, and wind-screen filters for the on-board microphone. You select options through menus displayed on the LCD screen.

DIGITAL STORAGE

Like all DV cameras, the Canon ZR digitizes and compresses video during capture, storing up to 90 minutes of video in digital format on the matchbox-size Mini-DV cassette. During still-image capture, the ZR holds each image for 6 seconds (which lets you create a short audio description of the image) and has about a 500-image capacity.



DON'T MOVE: *Canon's use of interlaced DV format means poor quality still-image capture in all but the lowest motion shots.*

DV is a high-quality format, featuring 500 lines of horizontal resolution, component color, and a high signal-to-noise ratio. This translates to noticeably better video quality than such analog formats as S-VHS, Hi-8, VHS, and 8mm.

The most significant advantage of DV is that it can be downloaded directly to specially equipped computers using an IEEE 1394 (FireWire) connection. Essentially a file transfer, this transaction doesn't degrade video quality. By contrast, the analog formats mentioned above are captured with traditional analog capture cards, which typically degrade quality even further.

PUT TO THE TEST

We tested the ZR in a number of conditions, indoor and outdoor, in bright and low light. In general, the camera was easy to point, hold steady, and shoot, especially when we used the viewfinder attachment. Controls were accessible and logical in operation, allowing a number of "no look" actions.

During our tests, we shot most video in automatic mode, finding that the programmed modes—particularly those for low light—produced disappointing results. As with most digital zooms, the ZR's picture became a bit fuzzy at high zoom ratios, so we disabled the digital zoom for most videos.

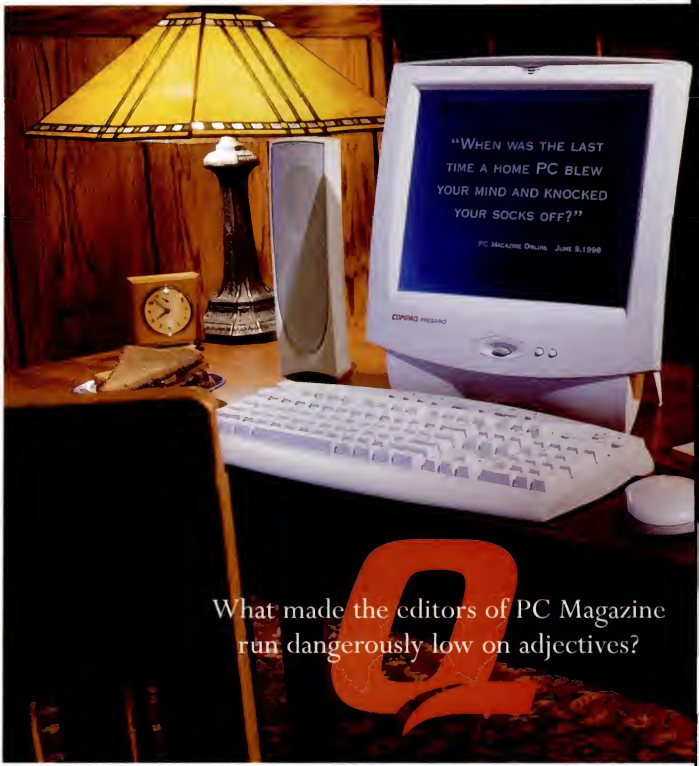
To test video quality, we shot side-by-side videos with the Sony PC-7 ($2,899 list), comparing the results on television and on disk after capture with the Miro DV300 FireWire adapter. In general, the ZR's video quality was noticeably superior, with sharp edges, crisp detail, and minimal noise and aliasing, though colors were slightly muted. During capture, the ZR worked well with both the DV300 and DPS Spark FireWire adapters, boding well for compatibility in the field.

Still-image tests were less positive, however, resulting from the camera's use of the interlaced DV format for still-image capture. When motion was minimal, still-image quality was excellent. But even moderate motion caused obvious deinterlacing artifacts, which manifest as visible slices and blurriness.

If video is your primary interest, the ZR is a great value and should lead DV's migration from the professional market into the consumer space.

Canon ZR Digital Camcorder. Street price: $1,400. Canon U.S.A. Inc., Lake Success, NY; 800-828-4040; www.usa.canon.com. *414 at www.pcmag.com/infolink.*

PHOTOGRAPHY BY THOM O'CONNOR



What made the editors of PC Magazine run dangerously low on adjectives?

The amazingly fast, gratifyingly complete, and irresistibly priced Presario 5600 Series* Internet PC, that's what. processor running at 400 MHz, plus a unique hardware-and-software package "geared toward enhancing your Add the $899' Flat Panel Monitor ("The picture COMPAQ quality you'll get from this For all the details on the machine that "redefines the state of the art for home PCs,"

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ACCOUNTING SOFTWARE

Be Your Own CPA

The newest version of Intuit's QuickBooks has multiuser support and even more ease-of-use features.

By Gayle Ehrenman

QuickBooks Pro has long been considered the small-business accounting package that's easiest to use. With Version 6.0 ($219 list), it gets even simpler for more people: For the first time, QuickBooks Pro offers multiuser support.

Version 6.0 marks the first 32-bit release of the product, which adds right-mouse-click menu access and faster performance. A host of new wizards help users set up everything from payroll items to multiple users. This version also adds register sorting (which makes viewing and managing register transactions easier), automatic flat-tax-rate calculations, payroll reports, and more tools that simplify report generation.

On the accounting front, QuickBooks now offers close dates, so accountants can restrict access to transactions of prior accounting periods. This functionality grows out of the program's new ability to set passwords and assign feature and activity access rights for each user.

Up to five employees can access the Multiuser QuickBooks data file simultaneously and even view the same transaction. The administrator determines which parts of the program each user can interact with and what actions they're allowed to perform. The program tracks who's logged on and who's editing a particular transaction. QuickBooks alerts those logged on when information has been changed and maintains a multiuser audit trail.

QuickBooks is the first small-business accounting package to offer online payroll and direct deposit services. The QuickBooks Online Payroll Service is integrated directly into the program's payroll feature and can automatically manage all payroll services.



TAKE CONTROL: *QuickBooks lets administrators determine user access by area and by activity.*

The Online Direct Deposit Service lets small businesses offer direct deposit to employees. Both services are being offered to a limited number of customers for a monthly service charge. Intuit expects to offer broader support next year.

Even if you don't need such sophisticated services, there's plenty worth looking at in QuickBooks. Though Peachtree Complete Accounting has long offered multiuser capability at no extra charge, QuickBooks is far easier for nonaccountants.

QuickBooks Pro 6.0. List price: $219 (single user); $599 (five-user value pack). Requires: 16MB RAM, 55MB hard disk space, Microsoft Windows 95 or NT 4.0. Multiuser requires Windows 95/NT peer-to-peer network or Windows NT server, or NetWare network. Intuit Inc., Mountain View, CA; 800-446-8848; fax, 800-858-6090; www.quickbooks.com. *413 at www.pcmag.com/infolink.*

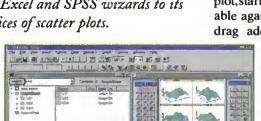
STATISTICAL SOFTWARE

Analyze Visually

MathSoft's S-Plus adds Excel and SPSS wizards to its Trellis graphs and matrices of scatter plots.

By Barry Simon

S-Plus started its life as a command-line statistical language. Now that MathSoft (the makers of MathCAD) has acquired S-Plus and Axum (the scientific graphing program), it has gained a visual soul. The Standard Edition ($780 list), which uses Axum technology, is simply a collection of graphical tools and 100-plus statistical procedures. The full-blown language, command line, and over 3,000 functions are available only in the Professional Edition ($1,995 list).



NEW MATH: *S-Plus features a variety of new graphing options.*

New to Version 4.5 are wizards for making OLE in-place editable S-Plus graphs in Excel or SPSS. There's also the ability to refit plots after visually eliminating outliers, drill-down capability in multiplot Trellis graphs, column transform with functions and menu interfaces to resampling, and cluster analysis.

S-Plus stands out for the ease with which you can analyze complicated data sets graphically. Select even noncontiguous data columns and you can create over 80 graphics types with the click of a button.

Unique to S-Plus are what it calls Trellis plots. To make such a plot, start with a plot of one variable against another and then drag additional variables to the two-variable plot. What results is a collection of two variable plots, one for each range of values of the variables.

Another strong point is the program's impressive array of import formats, including Gauss, MatLab, SAS, Sigma Plot, SPSS, and Systat. ODBC support also increases the import capabilities.

Statistical functionality includes regression (linear, user-defined nonlinear, and loess), ANOVA, MANOVA, cluster analysis, two resampling methods, ARIMA, two time-series methods, three survival methods, and four smoothing routines. The interface is a pleasure to use, with a variety of tool bars, multitabbed dialogs, and right-click menus.

It's natural to compare S-Plus with the SPSS 8.0, its most substantial competitor. S-Plus includes a wider array of statistical functions in its base product, whereas SPSS has more statistical functions available as extra-cost add-ons. Though Trellis plots give you some multivariable data slicing, they aren't as comprehensive as SPSS's Cross Tabs. On the other hand, graphics in S-Plus are better integrated, more intelligently set up, and easier to use. S-Plus is a superb tool for visual data analysis and statistical data mining.

S-Plus Standard Edition. List price: $780 (Professional Edition: $1,995). Requires: 32MB RAM, 80MB hard disk space, Microsoft Windows 95, 98, or NT 3.51 or later; MathSoft Inc., Seattle; 800-569-0123, 206-283-8802; www.mathsoft.com/splus. *412 at www.pcmag.com/infolink.*

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Second Looks

WINDOWS CE 2.0

Taking Sides

By Bruce Brown

We confess that we were not surprised by the strong opinions that our online readers had about Windows CE 2.0 devices, Palm Computing PDAs, and Microsoft's entry into the hand-held computing space (see the discussion on our Web site at *www.secondlooks.com*). Some people took a resigned attitude, suggesting that the Microsoft juggernaut is bound to overtake any market it enters; others focused on the technology, functionality, and usability of PDAs. Many have had experience with both Palm PDAs and Windows CE devices.

It's hard to start a conversation about Windows CE 2.0 devices without someone making comparisons with the PalmPilot and other Palm Computing models. The new palm-size Windows CE 2.0 devices—the Casio Cassiopeia E-10, Everex Freestyle, and Philips Nino—resemble the Palm Computing models, while the larger H/PCs—the Hewlett-Packard 620/660LX, NEC MobilePro 700/750C, and Sharp Mobilon—add physical keyboards and wider screens. The PalmPilot and palm-size Windows CE models were designed to serve primarily as personal reference devices, with the ability to synchronize task, schedule, and contact data with host PCs; communications accessories enable each one to be used for sending and retrieving e-mail and other online tasks. The Windows CE devices add other features, which readers either embrace or disparage.



When making comparisons between families of these one-handed devices, readers mention the Palm Computing family's fast startup and data access, long battery life, and simple user interface. Proponents suggest that Microsoft is making devices too complicated—with features such as voice recording—and that the Windows CE 2.0 operating system adds too much overhead. Users like the higher resolutions and brighter screens of Windows CE 2.0 units, and several respondents expressed approval for the Windows-like interface.

The bottom line at this point is that Windows CE 2.0 palm-size devices currently have more features than PalmPilot units, but they take longer to load data from scratch and definitely consume battery power more rapidly. If you want to extend the functionality of a hand-held, the Windows CE path today has more built-in features. For pure, simple, and fast personal data access, the Palm Computing models have the clear edge. Both worlds talk about thousands of developers working on applications for their respective devices. Palm Computing is certainly ahead today in shipping applications.

Users who want a hand-held for more than just reference and who want to do occasional work on documents and spreadsheets shouldn't even consider palm-size units. They should look at the tiny clamshell-like Windows CE 2.0 H/PCs and other competitive products, such as those from Psion and Sharp. Readers who use the HP 620LX and the Philips Velo 500 report happiness with the way those models work and augment their desktop computing tasks.

For greatest satisfaction with a PDA purchase, talk to people who use them first. You're sure to find users with strong opinions who are willing to talk.

COMPAQ DESKPRO EP

Pumped-Up Performance

By Carol Venezia

When we first looked at 400-MHz Pentium II PCs (May 26, 1998), we were impressed by the Compaq Deskpro EP's versatile chassis. But we weren't blown away by its performance. Compared with the other PCs in that roundup, the Deskpro's test scores were mediocre.



ORDER UP: *BuyDeskpros online at www.compaq.com*

Since our roundup, Compaq has addressed this issue. The company has introduced a configure-to-order program: Now, if you order your Deskpro either online from Compaq DirectPlus (*www.compaq.com*), or from a Compaq reseller, you'll be able to build up your machine with some of the hottest components on the market.

The Deskpro EP in our earlier roundup came with an ATI graphics accelerator and a Maxtor 6.1GB hard disk. Both contributed to its below-average Disk and Graphics WinMark scores. For a second look, we tested a 400-MHz Deskpro EP with two Compaq configure-to-order options: A Matrox Millennium G200 graphics board and a 10GB IBM 7,200-rpm hard disk.

With these new components, the Deskpro performed much better on our Graphics and Disk WinMark tests, with scores of 167 and 1,765, respectively (its earlier respective scores were 133 and 1,260). On both tests, these new scores place the Deskpro in the above-average range compared with the eight other machines in that roundup.

www.secondlooks.com

Tell us what you think... How do you like the new products you're using? Second Looks is your forum for feedback. Join us online to tell us about your experiences. We discuss a different new product every week and summarize your comments here. Below, you'll see what people had to say about Windows 95, now that Windows 98 is here.

Windows 95 *was supposed to make PC computing "easier"—instead, it made it more convoluted. I (stupidly) bought and installed Win95 right when it came out. There were problems galore, so I went back to Windows 3.1. A few months later, I reinstalled Windows 95, only to be faced with the same problems. Now, it is 3 years later, I've made several major hardware upgrades, and Windows 95 still sucks. The old problems have been replaced by new ones.*

—Name withheld

Sheesh. People need to get real. *Talking about the new Windows like it was a serious upgrade. Look at Windows 98 and you'll see that we all just paid for the biggest and most widely publicized beta test in history! Windows 95 was that test.*

—Name withheld

PHOTOGRAPHY BY TIONA O'CONNOR



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Upgrades: Finally Making Sense?

Company, halt! To the rear, march! I'm about to reverse course on a long-held belief. I've often said, in this column and elsewhere, that upgrades were a waste of time—that by the time some performance deficiency had surfaced in your machine, other performance deficiencies were lurking just below the surface, and that by upgrading one portion, you were just moving the bottleneck around. Even if you could overcome the various bottlenecks, it would be cheaper just to replace the whole machine.

That's no longer true, and here's why: The same economics and technical advances that make sub-$1,000 machines possible also allow you to upgrade your present machine selectively in a cost-effective manner. Processor, memory, and hard disk prices have fallen through the floor. Testing and isolating bottlenecks have become easier. Motherboard performance, for all but the highest-performance machines, has been at a plateau for several years. So improving the performance of the various systems plugged into a motherboard is feasible and sensible.

As a case in point, we'll take my wife Sharon's computer, a Dell Dimension P90. This is Mom's Machine, and she expects the configuration to remain stable and predictable over long periods of time. She doesn't like surprises. She wants to do her word processing, spreadsheets, Web searching, and light desktop publishing the way she's always done them. If I make a change, the benefit had better be blindingly obvious.

The Dimension gained another 16MB of RAM when I upgraded it to Windows 95, which was necessary to run all the 32-bit Web stuff. Sharon noticed, however, how slow her PC was compared with my 233-MHz K6, and it started to look really sad next to the new 333-MHz K6/2.

Meanwhile, the folks at Evergreen were looking for some test sites for their new family of Cyrix-based MxPro upgrade modules. I volunteered, of course, and they sent me 180- and 200-MHz versions to evaluate. Each module has a processor and a fan mounted on a carrier that drops right into the ZIF (zero insertion force) socket on the motherboard. Fan-motor and processor technology have combined so the two can draw current from the socket without exceeding the motherboard's ability to deliver power. This is a significant improvement over some earlier processor upgrade designs, which forced you to tap into a hard disk power socket or some other source to run the fan.



MOM'S MACHINE

Advances that make sub-$1,000 PCs possible also make cost-effective upgrades possible.

Evergreen's upgrade kit is well thought out, with a disk that guides you through the process and shows your system's performance before and after the installation. The 180-MHz processor drops into the CPU socket and boots right up. The 200 requires a jumper change on the motherboard to increase the motherboard's speed from 60 to 66 MHz, so you get the dual benefit of a faster processor and faster motherboard.

The jumper change was no big deal, but I went through it with a tech-support rep, because I thought the diagram was a bit unclear. Once changed, the 200-MHz processor ran perfectly, and it's been running ever since. It's had zero compatibility problems, and my wife would definitely let me know if it were doing anything strange.

Meanwhile, she's very pleased with the PC's increased performance, now in a league with the other machines around the house. The MxPro appears to have a slight edge over the equivalent Pentium OverDrive processor, in both price and performance. Computer Discount Warehouse and other direct marketers' sites list the MxPro 200 at $159 with 64K of on-board L1 cache, versus the Pentium part at $189 with a 32K cache.

The Evergreen also comes with MMX instructions, which don't matter in Sharon's work but help a couple of the games my son has squirreled away on her hard disk. Speaking of which, I can add another 3 gigabytes of storage if I'm so inclined, for $140 or so. That'll keep this system functional for a long time. It's already a happy member of our 3Com home LAN, sharing files, printers, and Web access. The PC doesn't need a better sound card than the SB 64 it already has. A USB port wouldn't help the system, nor would one of those grossly overrated "32X" CD-ROM drives. It doesn't need a 3-D graphics accelerator. It just needs the same things we all need: more room to put things and more time to do things.

That upgraded processor is the computer's equivalent of more hours in the day, and with storage costs hitting just pennies per megabyte, we have no incentive to replace this machine. PC

PHOTOGRAPHY BY BOB HILMGREN

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PC MAGAZINE — October 7, 1997 VisionMaster Pro 17

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New and Unimproved

There are a number of technologies around the corner that will be incorporated into the PC—whether we want them or not. Many of them will add functionality we don't need and won't use. Despite the illogic of some of these ideas, the makers persist for the simple reason that none of them know what they're doing. Here is how the mechanism works. (Cut out and save.)

A venture capitalist meets a screwed-up inventor who is strung out on cocaine. The venture capitalist is then sold on an idea that's simply ludicrous: let's say, to make a video monitor that also keeps hamburgers and french fries warm—a kind of built-in bun warmer. The capitalist invests money, helps build a company with a cool name, then goes to the same-old same-old conferences and pitches the product to the clueless attendees. If the presentation is good, they all get jazzed and talk about it over lunch: "Someday *all* monitors will have built-in hamburger warming."

The media, which is there looking for a story, picks up on the buzz and reports it.

MIAMI, August 14 (Reuters)—The Trends in Computing XI conference ended here today, with all the talk being about new LCD panels, PalmPilot software, and monitors that double as hamburger warmers. The last is expected to be a big trend, according to several analysts in attendance. "There is no question that hamburger warming is the future when it comes to monitor design," said Mark Donohue, lead investor for Cornwall Ventures. Other observers agreed....

Because this idiotic device was reported on and, frankly, because it was odd and interesting, *all* the computer magazines cover it. Then the columnists get into the act. A few pundits say it's stupid, but most (who seem to be in awe of the venture capitalists) go on and on about what a wonderful idea built-in hamburger warming is, and why hasn't someone thought of it before? "It's a good use for all the wasted energy a monitor expends."

Monitor makers, all panicked by the possibility that they'll be out of business overnight if this is indeed a trend (however dumb it may seem), each make announcements concerning the development. Some companies preannounce the hamburger-warming monitor while actually doing nothing but waiting to see whether others are successful. Others announce: "More research needs to be done in this area. It's not a trivial undertaking, and our company does not want to produce a product that isn't the best in its category." They also do nothing but wait. The venture-funded company goes ahead with the product and claims to be the leader in the category. A few panicky Taiwanese companies blindly follow suit, hoping to make names for themselves.



INNOVATION

"Someday *all* monitors will have built-in hamburger warming."

The media reports all this as news, which it is. Enough reporting is done that the shareholders of the wait-and-see monitor companies begin to question the judgment of the CEOs for "not moving faster in what appears to be a major trend." The media reports on this, too, thus frightening all the CEOs of all the monitor companies. The buzz is really going now.

The venture-capital–funded monitor company gets a good PR agency, which dreams up some numbers showing how important this development is. To kill time, surveys are conducted of the readers of the magazines that have been pumping the new monitor. "Do you plan or does your company plan to purchase a hamburger-warming monitor (choose one) (a) immediately, (b) within six months, (c) within a year, or (d) no plans?" Not wanting to look like dummies who are out of touch with trends—especially trends they read about in their favorite publications—all the respondents choose *a* or *b*, when in fact they have no idea whether they're really going to purchase the product, ever!

One or two large companies, under pressure from shareholders and the venture capitalists, announce plans to convert completely to hamburger-warming monitors. The media reports this plan, along with the survey results that say 94 percent of all those surveyed will switch to hamburger-warming monitors within the next six months.

The reports freak out all the monitor makers, other CEOs who thought the product was stupid, research companies that didn't see the trend, and magazines that didn't give it enough ink. Network TV, the last guys to find out about anything, jump all over it with a special Dan Rather report. Pretty soon hamburger-warming monitors are all anyone can talk about.

The monitors hit the market with a big thud and nobody buys them. All sorts of weird reasons for the failure emerge, mostly like "they were ahead of their time" or "they weren't executed properly," whatever that means. Meanwhile, we're off chasing the next big thing. Sound familiar?

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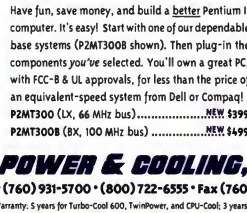
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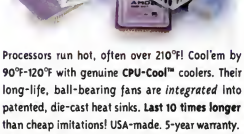


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JOHN C. DVORAK

Inside Track

New companies are being developed for the sole purpose of being sold to Microsoft or some other company. Few companies think they can make it alone anymore. That's pathetic.

More signs of a slowdown: the Inside Track formula. Many followers of this column sense there is an **underlying formula,** and various satirists have dissected it. I've always tried to introduce developments in the world of microprocessors at the beginning of Inside Track. This column broke the stories behind the Pentium, MMX, and other developments. Recently, I've had difficulty finding adequate chip news to write about. The only news to come out of Intel has been the delay of Merced and a couple of **boring new lines** of chips: Xeon and Celeron.

The computer industry has always been **driven** by semiconductor technology. New designs and ideas lead the way toward more powerful machines that create the opportunities for new software and peripherals. **Two things have changed** over the past few years. First, the software industry is a mess. Software companies have done nothing but add more bells and whistles, making the products nearly impossible to learn and use. This problem is compounded by the industry's failure to compete with Microsoft. No new categories have emerged because of the **fear that Microsoft** will copy them and put them out of business. This problem will worsen now that Microsoft appears to have the go-ahead to continue practicing business the way it has. That's one extreme. **The other extreme** is that new companies are being developed for the sole purpose of being sold to Microsoft or some other company. Few companies think they can make it alone anymore. That's pathetic.

The fact that software can't catch up with hardware has created a vacuum that has slowed the chip makers' frenetic pace. Though Moore's Law can't be stopped, consumer interest in **high-speed computing** will wane if the software business doesn't perk up. Some feel that **voice recognition** will be the ticket and that 500-MHz is the magic number for voice to work. From what I can tell, voice will not work well enough to become a killer application within the next ten years. OCR, which is an easier technology, is not at 100 percent reliability yet. None of this bodes well for the industry.

The second factor is the Internet. Research indicates that, given a choice between a faster computer and faster Internet access, today's user would prefer faster Internet access. In fact, today's computers are so I/O-bound at the WAN, LAN, and even disk I/O levels that processor speed is **less and less** important. The combination of I/O bottlenecks and uninteresting software is going to create **serious repercussions** in the business.

While on the Subject of Internet Access Dept.: At first I was **dubious** about **the dual Office-Connect 56K bridge/router** from 3Com. But having played with this type of device and compared it with my experience with overpriced ISDN service, I have to **applaud** it. My ISDN line mostly ran at 64K and sometimes switched to a full 128 Kbps (and cost me twice as much to connect). Every time the bonding clicked on or off, it cost me an additional 3 cents. After making about 70 phone calls on ISDN, I was charged for over 2,000 connections. With the dual 56K modem/bridge/router, not only do I have a nice router to use with my machines, but the dual 56K connection **averages 80- to 90-Kbps** minimum throughput at my location. That's a reasonable speed that can be shared by all the computers on the LAN. Of course, what I really want is ADSL at a flat rate.

When ADSL is widely deployed, there will be a boom in Internet activity. People will realize that they can put a server on the net 24 hours, 7 days, and serve pages efficiently to the world with full control. This is when Microsoft will seriously go after this market. Unfortunately, the phone companies are locking out various independent ADSL vendors. I will be discussing **this scandal** in the months ahead.

Genuinely Interesting Software Dept.: I've long lamented the death of XTree, the DOS-based file management utility. That is, until I **discovered ZTree,** an XTree clone developed by Kim Henkel at Zedtek. He's fixed all the problems with a complete ground-up recode. It can now handle long filenames and can log and organize over **a million files**! Download a copy from *www.ztree.com* for evaluation and registration is a mere $30 with unlimited upgrades. There has never been anything close to it for ease of use and versatility. Unfortunately, too many of **today's users don't understand** or appreciate the need for such a product. Worse, large inexpensive hard disks have made us all **sloppy** about disk housekeeping. But all the old XTree users will love this thing. ZTree's as good as it gets. This program works with Windows 95, 98, and NT, and there is even **an OS/2 version**!

Genuinely Interesting Hardware Dept.: If you've ever traveled with children who enjoy playing games on a laptop, you should have an inverter plugged into the car cigarette lighter to keep the machine fully charged. In fact, the new inverters, which turn your car's DC power into 120V AC, are handy for all sorts of things. The best unit I've seen is the $89.95 Tripp Lite, a 300-watt compact inverter with **dual AC plugs.** This thing also features a **low-battery alarm** in case you start to drain your car battery to excess. It even shuts down when unattended. Years ago, you'd never find anything like this at a price so low. Call Tripp Lite at 773-869-1234 for more information. Hot stuff.

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JIM SEYMOUR

Navigating the Shoals of PDAs

No one really needs a personal digital assistant (PDA); if you're happy with your Filofax, Letts, Day-Timer, Franklin Ascend, or other paper-and-pencil appointment book and note taker, you ought to stay with it. And deciding which PDA is right for you is a matter of working style and expectations, not specs. I can no more prescribe the right PDA for you without knowing what you need and how you work than I can find you the right job or car.

But I can tell you what I think about today's crop of new PDAs and which way I think the market is going. I'll get you thinking about what you really want and tell you about two little-known choices you may not have considered.

I've been a 3Com PalmPilot fan since the PDA appeared three years ago. Palm Computing turned the corner with the PalmPilot and wants to lock up market share with the new, top-of-the-line Palm III. Palm understands what previous pocket computer makers didn't: We don't need or want everything under the sun in our pocket rockets, just a few basic functions—our contact list and schedule and a way to take notes. Simplicity, small size, and low weight are what we're looking for.

The $399 Palm III meets those needs. But for many Palm users, it is also a disappointment: It doesn't go far enough. With awful timing, Palm opened the way for another viable hand-held computing standard: the new Windows CE 2.0 hand-helds.

I've been using a Palm III since it appeared, and that experience confirms my initial reaction: If you're a long-time Palm user, the Palm III is a logical if not quite essential upgrade. The larger and bolder typeface option, backlighting, and additional memory are worthwhile improvements. But the Palm III doesn't go far enough in expanding the functionality of the Palm platform. Think of it as the Palm II.5.

Palm has thousands of third-party developers, and they do some incredibly clever things. But Palm isn't advancing the state of the underlying platform quickly enough.

Indeed, among many Palm fanatics there's a strong sense that Palm must bring out another new machine shortly, both to satisfy existing Palm users' expectations and to fend off the Win CE 2.0 machines.

What's so appealing about the Win CE machines? The Win CE 1.0 hand-helds were jokes, but we're going to have to stop dissing Win CE. Take a look at the Casio Cassiopeia E-10, the best of the new breed.

The Cassiopeia is almost exactly the size and weight of the Palm III. But its display is contrastier, crisper, and easier to read, and the backlighting is far better. Even with its dim green backlighting turned on, the Palm III can be hard to read. To my eye, the Cassiopeia's twice as bright.



PDA STYLE

We don't need everything under the sun in our pocket rockets, just the basics.

Casio has a slightly better and easier-to-learn Jot-like handwriting recognition engine. Displays in the Win CE mini-apps are better organized; the appointments-and-tasks display is a model of clarity. The Cassiopeia synchronizes easily and reliably with a variety of desktop schedulers. And it has the single feature most obviously missing from the Palm III: voice recording, for quick notes. With 4MB of memory (expandable through CompactFlash cards, at a substantial cost to battery life), the Cassiopeia can accommodate those voice files.

Ah, battery life: the weak link for all hand-helds and the one area where the Palm III easily tops the Cassiopeia (and every other useful PDA). A Palm III will run for weeks on two AA batteries; plan on replacing your Cassiopeia's two AAs every week.

Still, the $399 Cassiopeia comes out on top, a better, more useful choice. And with the importance Microsoft is attaching to Win CE, the Cassiopeia will be around at least as long as the Palm platform.

As much as I like the Cassiopeia, it isn't the only good choice. Here's where we get into personal style: Exactly why do you want a PDA? What do you want to do with it? Will you carry it all the time or only occasionally?

If all you want is a contact list or contacts plus some appointments, look at Franklin's Rolodex Electronics REX PC Companion. This is a PDA anyone could love. The size of a credit card, it's easy to carry all the time. Its contrasty but non-backlit, 160- by 98-pixel display can't show much, but with some thought about your entries, that needn't be a problem.

I find keeping up with my appointments requires more screen real estate than any PDA offers. I need quick views of the month or two ahead, as well as weekly and daily details,

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JIM SEYMOUR

so I stick with the Ecco Pro (RIP) on the desktop and carry Ecco monthly and weekly schedule printouts. Add a shirt-pocketable REX and I've also got my 2,630-entry contact list, too.

If you like the way you keep your schedule now—in, say, a Day-Timer or Letts—but want a portable, easily editable contact list, the REX is for you. Just make sure you note changes to your REX-based contact list somewhere; you can't enter changes directly into the REX (it lacks an input device) but must instead do so on the PC that runs its full-scale contact application, TrueSync, or another standard contact manager (like ACT or Microsoft Outlook), then synchronize: a quick, no-brainer job. The upcoming REX Pro will allow rather clumsy direct entry with its SyperKey Light Data Entry System.

My other suggestion is the new NEC MobilePro 750C. NEC calls it a Win CE 2.0 hand-held, but even with my big hands, that's cheating: Call it an ultra-mini notebook. At 9.5 by 5.5 by 1.4 inches and 1.8 pounds, the 750C is half the size of subnotebooks and has proved in the couple of months I've been using it to be an excellent traveler.

I can't stick it in my pocket, but with its built-in mini-Word, mini-Excel, mini-Outlook apps and an external-display-only mini-PowerPoint, the 750C is far more capable than any PDA. The unit has a contrasty, backlit 640-by-240 color touch screen—a half-height VGA display. It has no cursor keys; you use its stylus to tap and drag for cursor movements. And it has a very usable keyboard.

I've been using a 750C as an e-mail machine on short trips. The built-in 33.6-Kbps modem helps, though Win CE's lamebrained initial set-up for dial-up accounts is a pain. A PCMCIA slot allows expansion of its 16MB of RAM or the use of a faster modem. (But does anybody ever get 56K performance in hotel rooms?)

If you carry a typical paper-based organizer (such as a standard 8.5- by 5.5-inch Filofax, not a pocketable Day-Timer), you can substitute a 750C with no penalty in size or weight. At $750, it's a bargain.

Which one's right for you? If you're already in the Palm camp, the Win CE 2.0 machines probably won't interest you; if you're not yet a pocket computer user, I can promise they will. If you're a minimalist, you'll love the REX. And if you can't see lugging a notebook everywhere—well, NEC has this little silver box for you.

Next time: what PDAs really need. PC

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BILL HOWARD

The Floppy Disk Paradigm Shift

What kind of floppy disk drive will I put in my next PC?" is not a question you lie awake at night pondering. In importance, it ranks somewhere between "Which Spice Girl will be quitting next?" and "Is Dan Quayle really going to run in 2000?" Except to the vendors, whose fortunes will rise or fall on this issue.

Still, we're on the cusp of another floppy disk standard. Since 1981, we've had three standards: the 360K floppy disk drive on the original IBM PC, the 1.2MB 5.25-inch floppy on the 1984 PC AT, and the now-ubiquitous 1.44MB 3.5-inch floppy on the 1987 PS/2—plus two minor standards that barely made it to market: the IBM 180K single-sided floppy disk and the IBM 2.88MB 3.5-inch floppy disk.

Not often do you hear *floppy disk* and *paradigm shift* used in close proximity. But with the next generation, we're poised for an order-of-magnitude, paradigm-shifting kind of leap. With removable disks of 100MB to 200MB, you'll have acceptable backup for many users and the ability to transfer multiple files that would otherwise span numerous 1.44MB floppies.

There are five competing, incompatible standards hoping to supplant the floppy disk drive. Except for Iomega and SyQuest, all read and write existing 1.44MB floppies. Expect the announced products to cost roughly $50 to $100 for a PC maker to incorporate, with disks costing about $10 each (versus $15 for a 1.44MB floppy disk drive and pennies for each disk). As a new-PC buyer, you'd pay about a $100 premium. Here's my take on the pros and cons.

Caleb Technology UHD 144. The dark horse, Caleb's disks hold 144MB, formatted. First production is scheduled for later this year, and the initial drive is desktop-only. Given the market clout of the other players, Caleb has an uphill battle. The verdict: Good luck.

Imation SuperDisk. Also called the LS-120, this is a 3M spin-off. Capacity is 120MB, and both desktop and portable versions are already shipping. There are several second-source makers, and the drive can be built on existing floppy disk drive production lines. This is not the fastest drive, but I suspect raw performance is not going to be an issue for most users. The verdict: Avis to Sony's Hertz?

Iomega Zip. Were it not for the compatibility issue, this would be Iomega's market to lose. There are 14 million–plus Zip Drives, with versions for the PC, notebook, and Mac. Performance is decent. Current capacity, 100MB, is passable. But the cartridges do not work with the existing base of floppy disk drives. So if the Zip Drive wins out over the floppy, there'll be a transition period of five years during which you'll have both, if the 5.25-inch-to-3.5-inch conversion is a guide. The verdict: The odds-on favorite.



NEW DISK ORDER

We're now poised for a paradigm-shifting leap in floppy disk technology.

Sony HiFD. This is the late entry with the least catchy name. With an expected launch in late summer/early fall, the HiFD looks like the best choice, on paper: 200MB capacity, fast data transfer, 3,600-rpm rotational speed, backward compatibility, famous maker. A lot hinges on the price, as Sony's design is more complex than that of the SuperDrive, with separate heads for 1.44MB and 200MB media. The verdict: Remember, Sony's design won out for 3.5-inch floppies a decade ago.

SyQuest EZFlyer, SyQuest SparQ. In terms of specs, the SyQuest products are like the Zip, only better: more capacity (230MB and 1.0GB, respectively), more performance, good price. The downside is that this is a hard disk technology at heart (raising media costs), is mostly a desktop drive, isn't backward-compatible, and doesn't have near the critical mass of the Zip Drive. The verdict: SyQuest wants to supplement your hard disk, not to replace the floppy disk drive.

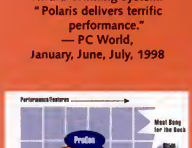
Who's going to win? If the PC industry going forward will be anything like the PC industry of the past decade, here are three clues. First, the technically superior product doesn't always win out. Otherwise, we'd probably all be using Macs today. Second, price is important. (Another reason we're not using Macs.) The third and perhaps most important clue is our preference for open standards and for innovation within existing standards. Think of IBM's PS/2 PCs with the Micro Channel architecture: technically superior, somewhat more expensive, initially proprietary, and requiring you to chuck your investment in existing add-in cards. So I suspect the Zip Drive has an uphill battle, but Iomega has been written off as dead before. Imation is a contender with some market penetration. Sony's spec looks great, and much depends on the pricing.

Five years down the road, I suspect all but one will be niches or memories. There will be only one winner.

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THE PC MAGAZINE 100 MOST INFLUENTIAL COMPANIES



ILLUSTRATION BY JACK HARRIS, ICONS BY DANIEL PELAVIN

BY JAKE KIRCHNER

INFLUENCE COMES FROM MORE THAN JUST COMPANY REVENUES. PC MAGAZINE SORTS OUT THE WHOLE STORY.

When we at *PC Magazine* last paused to chronicle the state of the personal computer industry—July 1997—we singled out the promise of Java, the potential of network computers, and the prominence of Netscape Communications Corp. as the leading stories. Fame is fleeting indeed.

We like to think the events of the intervening months say more about the dynamics of this most dynamic of industries than about our powers of analysis and description. After all, our task is to celebrate the moment's most influential companies in personal computing; it is not to identify the enduring trends of technology or commercial success. One lesson we have learned: Influence, as much as fame, is fleeting.

Once again we're led to conclude that in the PC business, change is still the only constant. Despite the judgment implicit in the recent action of several federal agencies that personal computing is a mature industry, easily manipulated by a brace of monolithic corporate giants, it is our conclusion that the industry is still, after two decades of existence, more entrepreneurial than conspiratorial, more chaotic than contained. How else can we explain the disappearance from our top-100 list of long-standing industry giant Digital Equipment into the embrace of Compaq, or the supersonic ascent of the aptly named Yahoo! from number 99 last year to number 13?

As before, this annual listing is our unabashedly subjective evaluation of the computing universe. Over the space of several months, some 3 dozen senior editorial staffers and contributing editors debated the relative influence of hundreds of companies. In the process, we considered annual revenues, key product lines, and market share, but the final rankings were not determined by financial success alone. You can't put a price on market influence and industry leadership. Some of the hottest companies in the business—and some of the highest-ranked in our estimation—are barely even profitable.

Of course, even the most subjective observations have to take history into account. In preparing this year's list, our deliberations had to accommodate the fact that 10 percent of the companies on our 1997 list disappeared (at least in name) through acquisitions and mergers. Not surprisingly, all continue to be represented on the top-100 list in their new corporate guises.

Last year's leaders—at least those not acquired or merged out of existence—are still represented in the top tiers of this year's rankings. Compaq and America Online muscled their way upward as Netscape and Toshiba slipped. Even more striking is the fact that this year's list features 20 percent fewer Internet companies than last year's.

Still, these businesses represent one-third of all companies on the list. And even if last year's push technology leaders PointCast and Marimba suffered in our estimation, with PointCast falling from number 19 to 72 and Marimba falling completely off the list, they were the exceptions to the continued strength of Internet companies. One notable example: In the process of pacing fellow upstart Yahoo! up the NASDAQ valuation curve, Wall Street darling Amazon.com earned its first appearance at a remarkable number 33.

Joining Amazon were 16 other first-time members of this PC cosmology. Separate articles in the following pages spotlight the strengths and weaknesses of four of them: @Home, Cendant, Rambus, and 3Dfx Interactive. We chose them for special attention here because we believe their stories, taken as a group, illustrate the profit and peril facing every company seeking to excel in this intensely competitive technological marketplace.

Speaking of peril, we should note that inclusion in the PC Magazine 100 does not necessarily signify that a company has "made it" in this business. As we've already seen, we can expect that a number of this year's chosen will not survive next year's scrutiny.

To us, that just makes the process all the more interesting. Even as we conferred, the PC world moved under our feet, leading us to continue tailoring the final list of 100 right up to press time. We will be disappointed if our choices don't engender some measure of controversy among our readers. Your comments and criticisms a year ago helped shape this year's compilation. We expect that will be the case again in the coming year.

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1 Microsoft Corp.

www.microsoft.com

Despite weathering heavy Justice Department investigation, Microsoft still has more control of the personal computer than any other single company. The Redmond, Washington company remains a dominant player in the Intel-based operating-system market—giving its application software easy entré to end-user desktops. After furthering this dominance with the introduction of Microsoft Windows 95 and Windows 98, CEO William H. Gates III plans for continued success with the workstation OS Windows NT 5.0. Microsoft continues to expand the scope of its OS business, developing basic platform software for handheld devices with Windows CE and for the Internet with Explorer. The success of OS products in turn feeds the success of business applications such as Office 97 and network-based products such as BackOffice, as well as gaming, educational, and finance software. After posting revenues of $11.36 billion for the fiscal year that ended June 30, 1997, Gates vowed to put nearly $2.6 billion into the company's research operation.

2 Intel Corp.

www.intel.com

Though cofounder Andy Grove (*Time*'s 1997 Man of the Year) relinquished his CEO title after 11 years of service, Intel is a long way from surrendering its hegemony in the microprocessor market. Former chief operating officer Craig Barrett took the reins as CEO of the company, which had $25.07 billion in 1997 revenues and whose CPUs are used in more than 80 percent of the world's personal computers. With manufacturing ramping up at unprecedented rates, two chips introduced before June 1997—the Pentium Processor with MMX Technology and the Pentium II—accounted for more than 90 percent of all Intel CPUs shipped in the fourth quarter. Although Cyrix and other competitors have made inroads into the sub-$1,000 PC market, the Santa Clara, California–based Intel is fighting back with the Celeron, a cacheless Pentium II with a mixed reputation among industry insiders in its first iteration.

3 IBM Corp.

www.ibm.com

Although the PC revolution has not always been kind to IBM, the company was able to post its first stock split in nearly 20 years. With CEO Louis V. Gerstner, Jr., at its helm, Big Blue posted 1997 revenues of $78.51 billion. And although the earnings of its hardware, software, client, and server divisions contracted slightly, the Armonk, New York company experienced growth in its OEM hard disk business. IBM reorganized its consumer PC business, while its Lotus division scored successes with Notes and Domino, and the Tivoli Systems subsidiary continued as a network management leader. IBM teamed up with Sun recently to offer JavaOS, an operating system based on Sun's Java language. IBM is arguably the technology leader in notebook computers and one of only a handful of companies able to provide service and support anywhere in the world.

4 Compaq Computer Corp.

www.compaq.com

CEO Eckhard Pfeiffer set out to achieve Compaq's corporate goal of becoming one of the three largest computer companies in the world by acquiring Digital Equipment Corp. From this merger, Compaq gains a worldwide service and support infrastructure and is better able to compete against IBM and HP. Compaq also sparked a minirevolution in the industry when it introduced the first sub-$1,000 PC. Compaq stumbled in executing its build-to-order plan, which was designed to manage inventory in the factory and at dealers. The company actually overshipped to retail dealers in the fourth quarter, leading to unexpected price cutting to move inventory. Still, the Houston company posted $24.58 billion in 1997 revenues.

5 Hewlett-Packard Co.

www.hp.com

Founded by Bill Hewlett and David Packard in 1938, HP holds the number-one position in the worldwide printer market. Commanding a strong global presence from Palo Alto, California, HP saw its revenues increase 12 percent from fiscal year 1996 to $42.90 billion for the fiscal year that ended October 31, 1997. Under the leadership of CEO Lewis Platt, HP has launched a new consumer branding campaign called "Expanding Possibilities"and is positioning itself as a manufacturer of both home and business products. HP has perhaps the broadest line of PC hardware, encompassing servers, PCs, laser printers, ink jet printers, color copiers, scanners, and cameras. The company is also betting that it can migrate its ink jet technology from home and office printing to fax printing, photo-realistic printing, and color copying.

6 Cisco Systems Inc.

www.cisco.com

With revenues of $6.44 billion for the fiscal year that ended July 26, 1997, Cisco Systems retains its leadership position in the fast-paced networking industry. Through the acquisition of companies such as Precept Software, Cisco continues to develop its strategy, focusing on networking solutions that incorporate voice, data, and video. The company's routers, switches, and server technology, integrated by Cisco IOS software to create powerful LANs and WANs, have become an ever-increasing part of the growing Internet. Cisco is based in San Jose, California, and headed by CEO John Chambers.

7 Sun Microsystems Inc.

www.sun.com

Much of the recent press about Sun Microsystems focused on its role as high-profile plaintiff in its lawsuit against Microsoft. Behind the courtroom drama, Sun has advanced the subject of the litigation, its programming language Java. This year, Java matured into Version 1.1 with the release of the Java Development Kit 1.1, and Version 1.2 of the language is already in the works. Although still only available in commercials, network computers (NCs) also loom large in the company's vision. In more traditional fields, Sun continued its dominance of the graphics workstation market, holding 39 percent of world unit sales. Under CEO Scott McNealy, the Mountain View, California company posted revenues of $8.60 billion for the fiscal year that ended June 30, 1997.

8 America Online Inc.

www.aol.com

America Online (AOL) emerged as the winner of the long-fought online services wars, providing a gateway to the Internet for some 14 million members. Chairman and CEO Steve Chase has led the Dulles, Virginia company through years of difficulty that brought busy signals, financial losses, and more than a few changes in its business model. But AOL acquired competitor CompuServe, handily turned away threats from The Microsoft Network, and

reported $1.69 billion in revenues for the fiscal year that ended June 30, 1997. In 1998, AOL expects to accelerate its momentum in Europe, strengthen its position in the small-business and professional market, and work in partnership with such companies as Microsoft and Excite.

9 Dell Computer Corp.

www.dell.com

Dell Computer, founded in 1984 by CEO Michael Dell, is a pioneer of the direct-sales model and a trailblazer in Internet commerce, ringing up about $4 million a day in sales through a configure-it-yourself Web site. One of the industry's fastest-growing companies, Dell pulled in revenues of $12.33 billion for the fiscal year that ended February 1, 1998, a 59 percent increase over 1997. Although best known for its PCs, notebooks, and servers, the Round Rock, Texas company recently expanded into the enterprise storage market with its PowerVault line of SCSI-based storage subsystems, tape backup systems, and scalable disk subsystems.

10 Netscape Communications Corp.

www.netscape.com

Despite its well-publicized battle with Microsoft and Internet Explorer, Netscape reported 1997 revenues of $533.9 million. Besides its popular Netscape Navigator, the Mountain View, California company continues to produce software products that encompass all parts of online life, including development tools, server software, and e-commerce applications. Under the direction of CEO Jim Barksdale, Netscape is trying to increase its 68-million-user client base through an unlimited-distribution plan, launched in conjunction with its move to make Communicator

Mapping Out the PC Magazine 100



1. **Microsoft Corp.** WA
2. **Intel Corp.** CA
3. **IBM Corp.** NY
4. **Compaq Computer Corp.** TX
5. **Hewlett-Packard Co.** CA
6. **Cisco Systems Inc.** CA
7. **Sun Microsystems Inc.** CA
8. **America Online Inc.** VA
9. **Dell Computer Corp.** TX
10. **Netscape Communications Corp.** CA
11. **Oracle Corp.** CA
12. **3Com Corp.** CA
13. **Yahoo! Inc.** CA
14. **Gateway Inc.** SD
15. **Adobe Systems Inc.** CA
16. **Apple Computer Inc.** CA
17. **Novell Inc.** UT
18. **Toshiba Corp.** JAPAN
19. **Macromedia Inc.** CA
20. **Intuit Inc.** CA
21. **NEC Corp./Packard Bell NEC** JAPAN/CA
22. **Softbank Corp./Ziff-Davis** JAPAN/NY
23. **Canon Inc.** JAPAN
24. **RealNetworks Inc.** WA
25. **Sony Corp.** JAPAN
26. **Bay Networks Inc.** CA
27. **Corel Corp.** CANADA
28. **Symantec Corp.** CA
29. **Silicon Graphics Inc.** CA
30. **Seiko Epson Corp.** JAPAN
31. **Lucent Technologies Inc.** NJ
32. **Seagate Technology Inc.** CA
33. **Amazon.com Inc.** WA
34. **Network Associates Inc.** CA
35. **Micron Technology Inc.** ID
36. **Autodesk Inc.** CA
37. **Creative Technology Ltd.** SINGAPORE
38. **GT Interactive Software Corp.** NY
39. **Ascend Communications Inc.** CA
40. **Computer Associates International Inc.** NY
41. **Advanced Micro Devices Inc.** CA
42. **Cendant Corp.** CT
43. **Adaptec Inc.** CA
44. **National Semiconductor Corp.** CA
45. **AT&T Corp.** NY
46. **Texas Instruments Inc.** TX
47. **International Data Group** MA
48. **Acer Group** TAIWAN
49. **Xerox Corp.** CT
50. **nVidia Corp.** CA
51. **Iomega Corp.** UT
52. **Rambus Inc.** CA
53. **ATI Technologies Inc.** CANADA
54. **Matsushita Electric Industrial Co. Ltd.** JAPAN
55. **Diamond Multimedia Systems Inc.** CA
56. **Dialogic Corp.** NJ
57. **S3 Inc.** CA
58. **MetaCreations Corp.** CA
59. **Western Digital Corp.** CA
60. **Matrox Graphics Inc.** CANADA
61. **Sharp Corp.** JAPAN
62. **Fujitsu Ltd.** JAPAN
63. **Hitachi Ltd.** JAPAN
64. **ViewSonic Corp.** CA
65. **Sybase Inc.** CA
66. **MCI Communications Corp.** DC
67. **Motorola Inc.** IL
68. **3Dfx Interactive Inc.** CA
69. **Logitech International SA** SWITZERLAND
70. **Inprise Corp.** CA
71. **Broderbund Software Inc.** CA
72. **PointCast Inc.** CA
73. **Gartner Group Inc.** CT
74. **Cabletron Systems** NH
75. **PC Connection Inc.** NH
76. **Activision Inc.** CA
77. **Cirrus Logic Inc.** CA
78. **Asymetrix Learning Systems Inc.** WA
79. **Quarterdeck Corp.** CA
80. **Philips Electronics NV** NETHERLANDS
81. **Informix Software Inc.** CA
82. **Quantum Corp.** CA
83. **Vocaltec Communications Ltd.** ISRAEL
84. **Lexmark International Inc.** KY
85. **SAP AG** GERMANY
86. **Samsung Electronics Co. Ltd./AST Research Inc.** KOREA/CA
87. **Phoenix Technologies Ltd.** CA
88. **Dragon Systems Inc.** MA
89. **Number Nine Visual Technologies Corp.** MA
90. **Eastman Kodak Co.** NY
91. **DeLorme Mapping Co.** ME
92. **Quark Inc.** CO
92. **Cidco Inc.** CA
94. **PeopleSoft Inc.** CA
95. **The Santa Cruz Operation Inc.** CA
96. **Rockwell Semiconductor Systems** CA
97. **@Home Network** CA
98. **In Focus Systems Inc.** OR
99. **The Learning Company Inc.** MA
100. **Computer Discount Warehouse Computer Centers Inc.** IL



*Estimated total-system price to end-users for Netfinity 5500 models 6649-11U (tower) and Netfinity 7000 model 8651-RMD (rack) and -TMD (tower). Certain features described on this sheet are available for an additional charge. Actual reseller prices may vary. MHz denotes microprocessor internal clock speed only; other factors may also affect application performance. Based on published TPC-C results of 11,070 tpmC as of 4/6/98. TPC and TPC-C are registered trademarks of Transaction Processing Performance Council. IBM, product names, and trademarks of International Business Machines Corporation. Microsoft, Windows and Windows NT are registered trademarks of Microsoft Corporation. Intel Inside and Pentium are registered trademarks of Intel Corporation. ©1998 IBM Corp. All rights reserved.



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and Navigator available for free. The company also made news in 1998 by making the Navigator source code publicly available and by making a strong entry into e-commerce with its Commerce Xpert line.

11 Oracle Corp.

www.oracle.com

Oracle is a developer of database software, client/server development tools, and related products. The company released the latest version of its popular database product Oracle8 in 1997 and is now working on a version of Oracle Lite for 3Com's Palm Computing platform. CEO Lawrence J. Ellison has been a vocal proponent of the network computer, which is designed to challenge the personal computer by lowering the cost of maintenance and upgrading, partly through the use of Oracle software. The Redwood Shores, California company posted revenues of $5.68 billion for the fiscal year that ended May 31, 1997.

12 3Com Corp.

www.3com.com

Computer, communication, and *compatibility* are the three *coms* that make up the name of this leading supplier of network hardware. 3Com manufactures remote-access products, hubs, network interface cards, and—through its Megahertz and U.S. Robotics subsidiaries—modems. The company's PalmPilot line of hand-held computers has proved extremely popular, selling more than 1 million units to date. The Santa Clara, California–based 3Com has flourished under the vision of CEO Eric Benhamou. After completing its acquisition of U.S. Robotics in June 1997, the company restated its sales for the year that ended May 31, 1997, from $3.15 billion to $5.61 billion.

13 Yahoo! Inc.

www.yahoo.com

Yahoo!'s influence on the Web remains strong, as it continues to be the most popular navigational site, and it is emerging not just as a search engine but as a *portal* to the Internet. The Santa Clara, California company reports that Web traffic increased to 65 million page views per day in December 1997. Along with that growth, net revenues for fiscal 1997 rose 253 percent over 1996, to $67.4 million. CEO Timothy Koogle plans to increase the company's services by creating partnerships such as the one with MCI to provide Internet access. Yahoo! also expects its free, personalized member services—such as My Yahoo! and Yahoo! Mail—to continue growing.

14 Gateway Inc.

www.gateway.com

Starting out in 1985 as a small direct seller of hardware peripherals and software, Gateway has become one of the nation's top PC manufacturers, with headquarters in North Sioux City, South Dakota. The number-two U.S. direct marketer of PCs (after Dell) posted 1997 revenues of $6.29 billion, a 25 percent increase over 1996. Under CEO Ted Waitt, Gateway plans to continue its growth with superior customer service and product innovations such as gateway.net, which made Gateway one of the first direct PC sellers to also become an Internet service provider. The company, formerly Gateway 2000, purchased all of Advanced Logic Research's common stock during the third quarter of 1997, crediting the acquisition with helping it create the NS series of servers.

15 Adobe Systems Inc.

www.adobe.com

Continuing its success in desktop and Web publishing, Adobe posted revenues of $911.9 million for the fiscal year that ended November 28, 1997. Consistent features, user interfaces, and functionality were added to Adobe Illustrator, PageMaker, and Photoshop to help move toward CEO John E. Warnock's goal of forming an online and print publishing solution that integrates all the company's graphics products. The Mountain View, California company also released a new version of PageMill (Web authoring software for Windows) and made inroads with FrameMaker (a publishing program). Although it remains a leading provider of software for the Apple Macintosh, Adobe continues to gain ground with its Acrobat line on the Windows platform.

16 Apple Computer Inc.

www.apple.com

Now under the leadership of interim CEO Steve Jobs, Apple has recently seen rough times, especially compared with its glory days in the 1980s. Although it holds a position among the top ten personal computer makers, Apple's revenues fell 28 percent to $7.08 billion for the fiscal year that ended on September 26, 1997. Several factors contributed to the decline, including the high cost of restructuring the company, the acquisition of Power Computing Corp., and a decrease in international revenues. The Cupertino, California icon plans to continue refining its product line with new versions of the Mac OS and new systems such as the Internet-ready iMac.

17 Novell Inc.

www.novell.com

During Eric Schmidt's first full year as CEO, Novell turned its attention to the Internet and corporate intranets. Still continuing its role as a provider of network software, Novell has refurbished core products such as NetWare and GroupWise to support Web applications. In a move to strengthen NetWare as a platform for open Internet applications development, Novell recently announced that it will embed the Java scripting language NetBasic 7.0, which it purchased from HiTecSoft, in its forthcoming NetWare 5. The Orem, Utah company posted revenues of $1.01 billion for the fiscal year that ended October 31, 1997.

18 Toshiba Corp.

www.toshiba.com

One of the world's largest electrical equipment companies, Toshiba is also one of the largest providers of notebook computers in the world. Formed in 1939 by the merger of two large Japanese appliance firms, the Tokyo company rose to prominence in the 1980s, when it started manufacturing consumer electronics and semiconductors. Toshiba suffered a setback in the past year, when it was forced to withdraw its line of home PCs from the U.S. because of poor sales. One of the codevelopers and prime movers behind DVD drives, the company posted worldwide revenues of $41.35 billion for the



ILLUSTRATIONS BY MICHAEL KLEIN

Cendant

When Howard Johnson Meets Batman

42

At Cendant Software's main office in Los Angeles, the scene is what you might expect at a hot software company: guys chewing the ends of their waist-length hair while studying the latest strategy game, an office filled with "X-Files" paraphernalia and screened with alien-head beads, and a state-of-the-art sound studio where an L.A.-gigging rocker by night works on music for kids' software by day.

What's unexpected is the man leading this troupe. Chris McLeod sits in his office calmly answering questions with complete focus. Even in business casual, he moves efficiently and officially, like a man accustomed to a suit and tie.



Cendant Software CEO Chris McLeod is turning his branding expertise to Blizzard Entertainment, Knowledge Adventure, and Sierra software.

McLeod's training comes from Cendant Corp., Cendant Software's parent and a $7.48-billion conglomerate with travel, real estate, and alliance-marketing divisions. Avis, Century 21, Coldwell Banker, and Howard Johnson are all part of Cendant; the software division accounts for less than 10 percent of total revenues.

The company makes its debut on the list this year at number 42 after CUC International's merger with HFS to form Cendant. Before he was named CEO of Cendant Software in January of 1997, McLeod was a 14-year CUC veteran who ran its international division and worked in its Comp-U-Card and Shopper Advantage divisions. At CUC he learned how to increase consumer awareness of a brand name—a mission for Cendant Software now.

"The marketplace is becoming much more mass-market with PCs selling for under $1,000," says McLeod. "When consumers come in, they're looking for the familiarity that a brand offers, and we're investing a lot in creating a brand on the entertainment side but also on the education side."

McLeod's branding initiatives at Cendant began with the consolidation of design groups under one of three umbrella brands: Blizzard Entertainment, Knowledge Adventure, and Sierra. Sierra focuses on such productivity titles as CompleteHome and the MasterCook series, and such entertainment packages as Police Quest and You Don't Know Jack. Blizzard's strategy games include Diablo and Warcraft, two best-selling titles with a war chest of awards from gaming magazines. Knowledge Adventure lines include the Blaster, JumpStart, and Playzone series, the last of which includes the Batman Activity Center.

Cendant Software is able to draw on the resources of its parent company to cross-market with other Cendant brands or simply to tap capital.

Being a relatively small part of the larger Cendant has also helped shield the software division from its parent company's persistent financial problems. As recently as July of 1998, Cendant was still struggling with accounting irregularities that arose in part from the 1997 CUC/HFS merger. The worst part, says McLeod, is that morale can suffer as announcements of diminished 1997 earnings hurt Cendant's stock.

While the division may be small in the scope of a multibillion-dollar international conglomerate's daily business, Cendant Software is no small player in the computer industry, holding a 12 percent market share and pulling in $378.6 million in software sales last year according to PC Data, a company that tracks retail sales.

McLeod is devoting a good deal of his time to flying around the world to make sure the design teams are producing better software and getting it out faster. "One of the reasons we've tried to stay decentralized is to move quickly," McLeod says. "In this industry, with the quick pace of change and the fact that it's still fairly easy for new developers to come out and enter the marketplace, unless we do we're going to die."

—Shannon Stevens

PHOTOGRAPHY BY ROBERT CARDIN

fiscal year that ended March 31, 1998, under president and CEO Taizo Nishimuro.

19 Macromedia Inc.

www.macromedia.com



Macromedia develops and markets cross-platform software tools for digital media and publishing. The San Francisco company reinforced its commitment to online publishing and entertainment in 1997 by introducing several new products designed specifically for the Web, including Dreamweaver, Fireworks, and Flash 2. Macromedia also improved Authorware, Director, and FreeHand for the Web. Web surfers continue to download Shockwave more than 1 million times per week, while the new ShockRave Web site serves as an interactive entertainment destination. CEO Robert Burgess led the company to $113.1 million in revenues for the fiscal year that ended March 31, 1998.

20 Intuit Inc.

www.intuit.com



Although it faces increasing competition from Microsoft's financial products, Intuit continued its growth in personal finance software with such products as Quicken and TurboTax. It posted revenues of $598.9 million for the fiscal year that ended July 31, 1997. The Mountain View, California company introduced in 1997 the Open Financial Exchange (OFX), a cooperative venture with Microsoft and CheckFree Corp. OFX creates a single, unified specification designed to let financial institutions exchange data over the Internet with consumers. Intuit also maintains the Web site quicken.com, which provides information about mortgages, insurance, investments, and other personal-finance topics. Intuit planned to move CEO William V. Campbell up to chairman and William H. Harris to president and CEO in August, 1998.

21 NEC Corp./Packard Bell NEC

www.nec.com, www.packardbell.com



NEC manufactures a wide range of electronic products and components, including semiconductors, telecommunications equipment, and PCs. A leader in the area of display technology, NEC is well known for its line of MultiSync monitors as well as its LCD flat-panel monitors, plasma displays, and projection devices. The Tokyo-based company in 1996 merged its worldwide computer operations outside Japan with PC maker Packard Bell, and it now owns part of Packard Bell NEC, which recently launched a configure-it-yourself direct-sales program called NEC Now. Piloted by chairman Tadahiro Sekimoto, NEC posted revenues of $36.85 billion for the fiscal year that ended March 31, 1998.

22 Softbank Corp./ Ziff-Davis Inc.

www.softbank.co.jp, www.zd.com



Founded in 1981 by CEO Masayoshi Son, global technology giant Softbank posted $3.87 billion for the fiscal year that ended March 31, 1998. In Japan, Softbank is a leading publisher of computer periodicals and the number-one distributor of computer software. Softbank remains the majority shareholder in Ziff-Davis, which merged Ziff-Davis Publishing with Softbank Forums and Comdex in late 1997 and went public in the U.S. in 1998. Under CEO Eric Hippeau, Ziff-Davis now publishes *PC Magazine* and other computer magazines, runs the Web site ZDNet, publishes market intelligence, and runs Comdex and other trade shows. The Tokyo, Japan–based Softbank also has stakes in memory maker Kingston Technology, and more than 50 other companies, including four on the PC Magazine 100: Asymetrix Learning Systems, GT Interactive, PointCast, and Yahoo!

23 Canon Inc.

www.canon.com



Led by CEO Fujio Mitarai, Canon is one of the world's leading suppliers of cameras, imaging products, and electronics equipment and is a major manufacturer of computer printers. Through its U.S. subsidiary Canon Computer Systems, the company sells its popular Bubble Jet printers and PowerShot digital cameras, as well as multifunction peripherals, scanners, and fax machines. In February, Canon and Kodak announced a $14,995 professional digital camera, which they developed jointly. The Tokyo company realized 1997 revenues of $21.24 billion.

24 RealNetworks Inc.

www.real.com



Previously known as Progressive Networks, RealNetworks is a developer of streaming audio and video software for the Internet. After going public in late 1997, the company completed its acquisition of Vivo Software, a maker of tools for creating streaming media. RealNetworks recently announced its new RealSystem G2, a client/server streaming media system that incorporates support for several standard media types, including AVI, MPEG, and WAV. CEO Rob Glaser led the Seattle company to $32.7 million in 1997 revenues, and Web surfers continue to download RealPlayer 5.0 at an average rate of more than 500,000 copies per week.

25 Sony Corp.

www.sony.com



Under the leadership of CEO Norio Ohga, global electronics and entertainment giant Sony posted revenues of $48.67 billion for the fiscal year that ended March 31, 1998. The company has a strong presence in the areas of consumer electronics, semiconductors, personal computing, music, and movies, and is striving to establish itself in emerging markets such as digital satellite broadcasting and network services. Codeveloper of the CD and the DVD, Sony also markets a line of computer products that includes the VAIO line of notebook and desktop PCs. One of Sony's Mavica digital cameras became a top seller in the U.S. by adding a 3.5-inch floppy disk drive, making for no-hassle transfer between camera and computer.

26 Bay Networks Inc.

www.baynetworks.com



Bay Networks is a leading manufacturer of networking infrastructure products such as hubs, routers, and switches. Perhaps best known for serving large companies, Bay Networks is also moving down market with its NetGear product line to service remote offices, small businesses, and even upscale home offices. In early 1998, Bay expanded

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nVidia at 50

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into the areas of network management and virtual private networks with its acquisitions of Netsation and New Oak Communications. Led by CEO David L. House, the Santa Clara, California company posted revenues of $2.09 billion for the fiscal year that ended June 30, 1997. In June 1998, the company announced a $9.1-billion merger agreement with Northern Telecom.

27 Corel Corp.

www.corel.com

Based in Ottawa, Ontario, Corel makes software for the business, graphics, and Web design markets. It markets the popular CorelDraw and Corel WordPerfect Suite and is developing Java-based software. Subsidiary Corel Computer Corp., spun off in June 1997, manufactures network computers and video-conferencing systems. Corel posted revenues of $260.6 million for the fiscal year that ended November 30, 1997, down more than 20 percent from the 1996 fiscal year. Although disappointed by the dip in the company's revenues, CEO Michael Cowpland said that continuing Corel's product strategy in combination with an ongoing investment in Java will bring higher revenues in 1998.

28 Symantec Corp.

www.symantec.com

Symantec is the leading developer of utility software for the Windows and Macintosh operating systems and the seventh-largest PC software company in the world. Based in Cupertino, California, it develops both application and system software with an emphasis on security and assistance, remote productivity, and Internet tools. The Norton product line has proved to be especially popular, and Norton CrashGuard has been one of the company's most successful products. Other popular products include Norton AntiVirus, Norton Utilities, pcAnywhere, and Visual Café. CEO Gordon Eubanks, Jr., led the company to $578.4 million in revenues for the fiscal year that ended April 3, 1998.

29 Silicon Graphics Inc.

www.sgi.com

Silicon Graphics ended a turbulent 1997 with Richard Belluzo stepping in as CEO to stabilize the Mountain View, California company after a period of resignations, layoffs, and fluctuating stock performance. The company, long established as a vendor of Unix and RISC-based systems, posted $3.66 billion in revenues for the fiscal year that ended June 30, 1997. Silicon Graphics plans to introduce a more mainstream computer based on an Intel chip; the company's workstations are used in product engineering, computer simulation, and data warehousing. They are also a favorite in Hollywood postproduction facilities, used to add special effects for such recent films as *Alien Resurrection* and *Starship Troopers*. SGI retains a majority stake in MIPS Technologies, which was spun off in June 1998.

30 Seiko Epson Corp.

www.epson.com

Based in Nagano-ken, Japan, Seiko Epson Corp. is one of the three core companies of the 60-company Seiko Group. Subsidiary Epson America, like its corporate parent, first achieved success by making timekeeping devices. Led by CEO Norio Niwa, today Epson America manufactures and markets digital cameras, LCD projectors, and scanners in addition to its popular Stylus line of ink jet printers. Seiko Epson posted $6.13 billion in revenues for the fiscal year that ended March 31, 1998. CEO Hideaki Yauskawa expects to continue the company's growth in 1998 with products for the home and SOHO markets.

31 Lucent Technologies Inc.

www.lucent.com

A spin-off of various parts of AT&T and Bell Laboratories, Lucent Technologies competes in the global communications networking industry with products for the wired, wireless, microelectronics, and voice/data/video markets. The Murray Hill, New Jersey company posted revenues of $26.36 billion for the fiscal year that ended September 30, 1997. The company purchased Octel Communications (a provider of voice, fax, and electronic messaging technologies), Prominet (a developer of Gigabit Ethernet products), Livingston Enterprises (a producer of LAN/WAN connectivity products), and Yurie Systems (a maker of ATM products). Richard A. McGinn became CEO of Lucent in 1998.

32 Seagate Technology Inc.

www.seagate.com

A manufacturer of storage technology, tape drives, and disk drives, Seagate also provides network information management software such as Backup Exec, Crystal Info, and Crystal Reports. Seagate's Quinta Corp., a wholly owned subsidiary, unveiled a technology that can store the equivalent of more than 45 copies of the 32-volume *Encyclopædia Britannica* in the space of a postage stamp. The Scotts Valley, California company posted $8.94 billion in revenues for the fiscal year that ended June 26, 1997. Industry icon Alan Shugart was replaced as CEO by Stephen Luzco in July 1998.

33 Amazon.com Inc.

www.amazon.com

Amazon.com advertises that it is the Earth's biggest book and music store, offering more than 3 million titles. So far the company reports that it has sold books, CDs, DVDs, and computer games to 2.2 million people in 160 different countries. The Seattle-based company plans to expand its customer base by offering resources such as customer reviews, personal recommendations, and gift suggestions. Amazon.com

MERGERS & ACQUISITIONS



MERGED:

- **CUC International Inc. merged with HFS Inc. to form Cendant Corp.**
- **McAfee Associates Inc. merged with Network General Corp. to form Network Associates Inc.**
- **MetaTools Inc. merged with Fractal Design Corp. to form MetaCreations Corp.**

ACQUIRED:

	ACQUIRED BY:
Aimtech Corp.	Asymetrix Learning Systems Inc.
CompuServe Inc.	America Online Inc.
Cyrix Corp.	National Semiconductor Corp.
Digital Equipment Corp.	Compaq Computer Corp.
Firefly Networks Inc.	Microsoft Corp.
Power Computing Corp.	Apple Computer Inc.
U.S. Robotics Corp.	3Com Corp.



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CEO Jeff Bezos founded the company in July 1995 and brought it public in May of 1997. The company's 1997 revenues were $147.8 million, a more than 800 percent increase over the preceding year.

34 Network Associates Inc.

www.networkassociates.com



Network Associates was formed in 1997 by the merger of McAfee Associates and Network General, a network performance management company. The Santa Clara, California-based company's product lines include CyberCop, Sniffer, Virus-Scan, WebShield, and the well-known PGP encryption software. Combining McAfee's antivirus, security, and help desk software with Network General's network management products, Network Associates posted $612.2 million in 1997 revenues. Remaining as CEO is William Larson, who has led the company through a flurry of acquisitions, including Pretty Good Privacy, Magic Solutions, Secure Networks, Trusted Information Systems, and Dr Solomon's Group.

35 Micron Technology Inc./ Micron Electronics Inc.

www.micronpc.com



Micron Technology, founded in 1978 by Ward and Joe Parkinson, manufactures DRAM components, graphics DRAM, synchronous SRAM, and flash memory. With CEO Steven R. Appleton at the helm, the Boise, Idaho company had sales of $3.51 billion for the fiscal year that ended August 31, 1997. Micron Technology owns a majority (64 percent) of subsidiary Micron Electronics, a manufacturer of direct-sales PCs and servers for the consumer, business, government, and education markets. Recently, the company introduced two PCs in its Millennia line that incorporate Intel's Pentium II/400 microprocessor, a new 100-MHz bus, and DRAM technology.

Micron Electronics is now led by newly appointed CEO Joel Kocher; it had sales of $1.95 billion for the fiscal year that ended August 31, 1997.

36 Autodesk Inc.

www.autodesk.com



Autodesk brought computer-aided design to the PC desktop in 1982 when it introduced its flagship product, AutoCAD. Sixteen years later, the San Rafael, California company claims 1,816,000 copies of AutoCAD shipped and 3 million customers. Under CEO Carol Bartz, the company posted record net revenues of $617.1 million for the fiscal year that ended January 31, 1998. Through the 1990s, it has expanded into numerous design-intensive fields, either by creating new divisions such as Kinetix, which developed 3D Studio MAX, or through acquisitions. In 1997, the company took the plunge into the consumer market with the software series Picture This Home!

37 Creative Technology Ltd.

www.creaf.com



A powerhouse manufacturer of sound cards and multimedia upgrade kits, Creative Labs posted $1.23 billion in revenues for the fiscal year that ended June 30, 1997. Headquartered in Singapore and run by CEO Sim Wong Hoo, the company is better known in the U.S. through its wholly owned subsidiary Creative Labs. In 1998 Creative Technology will continue to focus on such multimedia products as its PC-DVD line and its Sound Blaster AWE64 Gold. Creative Technology also bought Cambridge SoundWorks, a direct seller of home and PC audio.

38 GT Interactive Software Corp.

www.gtinteractive.com



GT is one of the largest companies in the gaming industry and is the distributor for video game developers such as 3D Realms, creator of the popular Duke Nukem 3D. The company operates software creator Cavedog Entertainment, which found notable success with Total Annihilation. GT has become a developer in its own right with the acquisition of SingleTrac Entertainment Technologies, the creator of Sony PlayStation titles. The company is also gaining ground in the children's software market with its purchase of Humongous Entertainment, creator of the Putt-Putt series and other titles. Led by president and CEO Ronald W. Chalmowitz, the New York company posted $530.7 million in 1997 revenues.

39 Ascend Communications Inc.

www.ascend.com



Ascend recently acquired Cascade Communications, forming the base of its Core Systems Group and establishing itself as one of the largest providers of frame-relay and ATM equipment to service providers. Under CEO Mory Ejabat, the Alameda, California company finished 1997 with sales of $1.17 billion, a 31 percent increase over 1996's $890.3million. Ascend's growth is expected to continue in 1998 with its rebirth as a broad-based supplier of wide area networking products to large ISPs and telecommunications carriers on four continents.

40 Computer Associates International Inc.

www.cai.com



Computer Associates could be considered the monster that ate corporate computing, owing its voracious growth to the acquisition of other software developers. Under longtime chairman and CEO Charles B. Wang, Computer Associates scored a success with Unicenter TNG, a collection of tools and applications that manage enterprise computing. Computer Associates' collaboration with Fujitsu has finally born fruit with Jasmine, the long-anticipated object-oriented database and applications development environment. The Islandia, New York–based company posted $4.72 billion in revenues for the fiscal year that ended March 31, 1998, setting its sites on client/server applications.

41 Advanced Micro Devices Inc.

www.amd.com



Led by CEO William J. Sanders III, AMD provides integrated circuits, microprocessors, flash memory products, and programmable logic devices to the computer industry. The company has been making inroads in the Intel-dominated microprocessor market with the AMD-K6 line of processors, which have been used by such PC makers as Compaq and IBM. AMD recently introduced a 300-megahertz version of the K6, as well as the new K6-2 processor with 3DNow! technology, a set of 3-D instruction extensions that improve multimedia performance. The Sunnyvale, California company reported 1997 revenues of $2.36 billion.

TOTAL REVENUES

$880 billion



The total revenues of all the companies on the PC Magazine 100 are greater than the combined 1997 gross domestic products of Canada ($599 billion), Ireland ($72 billion), and New Zealand ($66 billion).

Rambus

A Single-Mindedness for Memory

52

Talk about sticking with a vision. Rambus has been working for eight years to deliver on its original game plan—to develop the next generation of PC main memory.

Along the way, the company took a few detours to prove that its technology worked and could be manufactured in quantities as high as millions of units. No problem. Rambus technology has been adopted by several graphics workstation manufacturers as well as the best-selling video game player Nintendo 64.

And Intel plans to support Rambus technology in chip sets for high-end PCs due out next year. By 2001 Rambus memory will be used in 46 percent of all PCs, and by 2002 in 57 percent, according to the market research firm In-Stat of Scottsdale, Arizona.



Rambus CEO Geoff Tate is sticking with his story: Faster PCs need faster memory.

That kind of influence vaulted Rambus to number 52 on the PC Magazine 100 in its first year on the list, besides bringing an impressive 132.1 percent increase in revenues to $26 million in the fiscal year that ended September 30, 1997, compared with $11.2 million in the previous year.

What makes Rambus memory better? As microprocessor speeds escalate to 400 MHz and beyond, the rest of the memory subsystem has not kept up, effectively muzzling total system performance. Rambus memory can transfer data at 600 to 800 MHz—a huge leap past the current 100-MHz speed of SDRAM. Rambus offers a faster memory controller chip with fewer wires. Adding wires increases the amount of data you can transfer, but it also adds cost. "If you can transfer more per wire, you're going to have the most performance," says Rambus CEO Geoff Tate.

What's more, the Rambus design offers plenty of headroom. "We provide a path for a lot more than a one-shot fix to the bandwidth problem," says Tate. "If Intel used the same number of pins on the controller chip that it now assigns to its SDRAM bus, it could have two Rambus connections and a sixfold increase in performance."

The company plans to offer the third generation of memory for PCs through a variety of DRAM manufacturers that have licensed the technology. Tate says the cost of its RDRAM will be only "a little bit more" expensive for manufacturers to achieve a big performance boost. "We get high performance not through high-cost approaches," he says, "but by squeezing a lot more performance from technology that already exists."

Rambus licenses its designs to manufacturers so it can focus on marketing and design without running a billion-dollar fab. Without the distraction of manufacturing, Tate says, his engineers can focus on where the market is going rather than where it is.

And just where is that? Rambus expects to help power a new generation of PCs with such features as ultrarealistic multimedia, voice recognition, and 3-D interfaces. And not just on the high end. "If you want to build a sub-$1,000 PC with 128MB of RAM," Tate says, "you'll be able to do it with a single DRAM, instead of the eight you need today with SDRAM."

SDRAM is considered state-of-the-art memory today, but Tate contends the technology is "running out of steam" when it comes to newer applications that will provide *Jurassic Park*–like graphics realism. "To do those kinds of graphics requires hundreds of times more processor performance and commensurate increases in memory performance," he says.

While other companies are working on new approaches to improving memory performance, Rambus claims the lead, with its Intel relationship and announcements from Compaq and Dell that they will ship machines with RDRAM technology next year. Sticking to the game plan, it seems, has proved a winning strategy.
—*David Needle*

42 Cendant Corp.

www.cendant.com

This multi-industry giant hit a snag in 1998 when it twice announced that accounting irregularities (resulting in part from the logistics of the December 1997 merger of CUC International with HFS) had diminished 1997 earnings and sent the company's stock reeling. Under CEO Henry R. Silverman, the company is a prominent player in many industries, including software. Cendant owns such companies as Sierra On-Line (publisher of the After Dark screen savers), Knowledge Adventure (with its JumpStart educational software), entertainment software giant Blizzard Entertainment, and the multifaceted Davidson & Associates. (See the sidebar "When Howard Johnson Meets Batman.")

43 Adaptec Inc.

www.adaptec.com

Adaptec is a leading manufacturer of high-performance I/O and connectivity products, including SCSI adapters, RAID products, ATM network interface cards, fast Ethernet adapters, and server management software. The Milpitas, California company also makes CD-R software such as CD Creator, DirectCD, and Toast. In April 1998, Adaptec announced its intention to acquire Ridge Technologies, a maker of RAID and Fibre Channel storage solutions for Windows NT servers. Under the direction of CEO Grant Saviers, the company posted revenues of $1 billion for the fiscal year that ended March 31, 1998.

44 National Semiconductor Corp.

www.national.com

A leading manufacturer of chips and semiconductor products, National Semiconductor had revenues of $2.68 billion for the fiscal year that ended May, 25 1997. National spun off its Fairchild Semiconductor unit in early 1997 and acquired Mediamatics, a manufacturer of MPEG audio/video decoders. The Santa Clara, California company pushed still farther into the market with its acquisition of chip maker Cyrix, which is challenging Intel with its 6x86MX PR266 microprocessor. The merger has put National Semiconductor in a position to move toward CEO Brian Halla's vision of the PC-on-a-chip, a cheaper and more reliable alternative to systems that use multiple components.

45 AT&T Corp.

www.att.com

AT&T capped its first year under new CEO C. Michael Armstrong with $51.32 billion in 1997 revenues. In an effort started under previous CEO Robert E. Allen, the New York–based company has refocused on its core business—telecommunications—by spinning off several divisions, including NCR (which it had used to enter the computer marketplace), Lucent Technologies, and its Universal Card credit card operations. When it entered the Internet service provider business in early 1996 (long after many of its rivals), AT&T used its massive telecommunications infrastructure and huge service organization, along with the power of its name, to catapult its WorldNet service to the front of the pack. With the purchase of Teleport Communications Group, the largest of an emerging class of companies offering local phone services to businesses, AT&T has gained a toehold in the lucrative local-business market.

46 Texas Instruments Inc.

www.ti.com

Dallas-based Texas Instruments bounced back after a rough 1996. The dramatic measures that CEO Thomas Engibous took last year, including selling off entire businesses, such as the company's notebook and printer divisions, had their desired effect. The U.S. electronics giant brought in $9.75 billion in 1997 revenues and returned to profitability after a year in the red. TI is the industry leader in the digital signal processing (DSP) technology used in analog modems and ADSL, and it continues to make improvements to its line of digital micromirror devices (DMDs), found in lightweight portable projectors.

47 International Data Group

www.idg.com

International Data Group is one of the world's largest publishers of computer-related information, with 285 magazines published in 75 countries and more than 500 book titles, including the popular "...for Dummies" series. International Data Corp., the research arm of IDG, provides information technology data, analysis, and consulting and has research centers in 41 countries. Boston-based IDG also produces technology conferences, maintains a number of technology-specific Web sites, and provides marketing services and computer training. Led by founder and CEO Patrick J. McGovern, the privately held company recorded estimated 1997 sales of $1.9 billion.

48 Acer Group

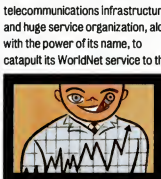
www.acer.com.tw

Acer is one of the PC industry's largest manufacturers, ranking in the top ten worldwide for market share and employing more than 23,000 people in 44 countries. The Taipei, Taiwan–based company, led by CEO Stan Shih, makes a number of popular desktop and notebook PCs such as the Acer Aspire and TravelMate series. Acer is also a major original equipment manufacturer of monitors and components. Following $6.3 billion in 1997 revenues, the company continued its long period of growth this year with a buyout of Texas Instruments' share in their joint DRAM manufacturing effort, part of Acer's effort to become a player in the semiconductor business.

49 Xerox Corp.

www.xerox.com

Copier giant Xerox has expanded beyond its origins in xerography and today makes a wide range of supplies and hardware that create and manage printed or digital documents. The Stamford, Connecticut company is pushing full tilt into the digital and networking age with its DocuPrint line of digital printers, which can incorporate individual transaction data from networks into one-to-one communications such as bills and statements. The company also brought out the DocuColor Office 6, a networked, Adobe PostScript 3 color



The top five revenue increases on the PC Magazine 100...

	1997	1996	Change
GROWING			
@Home Network	$7.4	$0.7	+957%
Amazon.com Inc.	$147.8	$15.7	+841%
nVidia	$29.1	$3.9	+646%
3Dfx Interactive	$44.1	$6.4	+589%
PointCast	$18.0	$5.2	+246%

Dollar amounts in millions.

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The projector that won PC Magazine's Editors' Choice Award just got brighter—the new In Focus LP425 personal projector. It fits in the same bag with your notebook and has 700 lumens of brightness, yet weighs just 6.8 pounds. And, as the industry leader, we've got a full line of projectors to choose from, including this—the world's smallest.

InFocus®
Project yourself.™

DLP® A TEXAS INSTRUMENTS TECHNOLOGY

DISPLAYMate Best Image Quality DLP

Mobility Awards

PC Magazine Editors' Choice

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copier/printer for the office. Xerox posted 1997 revenues of $18.17 billion with CEO Paul A. Allaire at its helm.

50 nVidia Corp.

www.nvidia.com

A supplier of high-performance graphics accelerators, five-year-old nVidia aims to become the world leader in 3-D graphics technology. Its RIVA 128 chip, a combined 2-D/3-D solution, forms the core of several award-winning add-in boards from Diamond Multimedia and STB and is also bundled with PCs from Dell, Gateway, and Micron Electronics. nVidia's latest chip, the RIVA TNT 3-D processor, is designed for fast photo-realistic graphics processing. Led by CEO Jen-Hsun Huang, the privately held Sunnyvale, California company had estimated 1997 revenues of $29.1 million.

51 Iomega Corp.

www.iomega.com

Iomega continued its dominance of the removable-storage market in 1997, posting $1.74 billion in revenues. Best known for its popular Zip Drive, which recently reached a milestone of more than 12 million units shipped worldwide, Iomega also makes the higher-capacity Jaz drives and the Ditto line of tape backup products. The Clik! line offers mass storage for portable products such as digital cameras and handheld computers. Iomega is based in Roy, Utah, and is now headed by acting CEO James E. Sierk.

52 Rambus Inc.

www.rambus.com

Rambus designs and sells high-speed memory that can dramatically increase PC performance compared with machines using conventional DRAM. Its technology is licensed to several semiconductor makers, including IBM, Samsung, and Toshiba, and also acts as the basis of many networking products and digital video/television receivers, including the video game system Nintendo 64. Under CEO Geoff Tate, the Mountain View, California company's revenues doubled in the past year, reaching $26 million for the fiscal year that ended September 30, 1997. (See the sidebar "A Single-Mindedness for Memory.")

53 ATI Technologies Inc.

www.atitech.com

A manufacturer of add-in graphics cards and graphics components, ATI has been on a roll since the introduction in 1996 of its RAGE PRO chip set, which was the first to combine 2-D and 3-D acceleration. Based in Thornhill, Ontario, ATI was also first out the door with an AGP-enabled graphics product, and its latest chips include DVD support. Led by president and CEO K.Y. Ho, ATI posted $434.2 million in revenues for the fiscal year that ended August 31, 1997.

54 Matsushita Electric Industrial Co. Ltd.

www.panasonic.com

The parent company of Panasonic Communications & Systems Co., Matsushita posted revenues of $59.78 billion for the fiscal year that ended March 31, 1998. Matsushita's audio and electronics products are marketed in the U.S. under the names JVC, Panasonic, Quasar, and Victor. Led by CEO Yoshinori Kobe, the Osaka, Japan–based company manufactures a variety of computer peripherals, including scanners, printers, monitors, and PC speaker systems. Matsushita is also a leading manufacturer of CD-ROM drives and one of the pioneering companies behind DVD technology.

55 Diamond Multimedia Systems Inc.

www.diamondmm.com

Under CEO William J. Schroeder, Diamond Multimedia Systems posted $443.3 million in 1997 revenues and maintained its reputation as a leader in interactive multimedia. Best known for 2-D/3-D graphics cards such as the Diamond Monster 3D II and audio cards such as the Diamond Monster Sound M80, the San Jose, California company also makes the SupraExpress line of modems and the FirePort line of SCSI adapters. Diamond recently signed an agreement to acquire Micronics, a maker of PC motherboards and multimedia peripherals sold under the Orchid brand name.



...and the top five revenue decreases on the PC Magazine 100

SHRINKING

	1997	1996	Change
Number Nine Visual Technologies Corp.	$47.2	$118.5	– 60%
Quarterdeck Corp.	$83.8	$133.1	– 37%
Informix Software Inc.	$662.3	$939.3	– 29%
Apple Computer Inc.	$7,080.0	$9,830.0	– 28%
Novell Inc.	$1,010.0	$1,370.0	– 26%

Dollar amounts in millions.

56 Dialogic Corp.

www.dialogic.com

Dialogic manufactures high-performance computer telephony components that are used in voice, fax, data, speech synthesis, ISDN networking, and call center management applications. Under the supervision of CEO Howard Bubb, Dialogic posted $261.3 million in 1997 revenues. Based in Parsippany, New Jersey, Dialogic also released products incorporating its new DM-3 Mediastream processor, which can handle multiple computer telephony media technologies simultaneously.

57 S3 Inc.

www.s3.com

S3 makes multimedia accelerator chips, from its ViRGE family of graphics and video accelerators to its SonicVibes audio accelerator. The company sells its products to such companies as Compaq, Toshiba, and Turtle Beach, which use the chips in their systems and add-in cards. S3 recently announced a deal to incorporate its texture-compression algorithm into Microsoft DirectX 6.0. Based in Santa Clara, California, S3 posted 1997 revenues of $436.4 million under the leadership of CEO Terry Holdt.

58 MetaCreations Corp.

www.metacreations.com

Graphics software company MetaCreations is a result of the 1997 merger between MetaTools and Fractal Design and the acquisitions of Real Time Geometry Corp. and Specular International. The new company makes a variety of products, ranging from consumer creative tools to professional 2-D and 3-D design programs all the way to professional video special-effects software. MetaCreations developed a 3-D scanner that uses mathematically based software and hardware innovations

3Dfx

More Than Just Fun and Games

68

Just don't call 3Dfx a chip company. "We think of ourselves more as an entertainment company," says Greg Ballard, president and CEO of 3Dfx Interactive.

True to that sentiment, Ballard has recruited marketers from the movie, record, and video game businesses since he joined in 1996, and the strategy has paid off. The four-year-old company's 3-D accelerator powers several popular add-in cards sold at retail such as the Canopus Pure 3D, Creative Labs 3D Blaster Voodoo2, and Diamond Monster 3D II. The company increased revenues from $6.4 million in 1996 to $44.1 million in 1997, an almost sevenfold gain that scored as the third-largest in the PC Magazine 100.



3Dfx president and CEO Greg Ballard wants to make 3-D graphics as essential to all PC users as it is to gamers.

3Dfx has kept its edge by establishing relationships with leading game software developers to ensure that it can maximize game performance. More than 250 3-D games support its chip set, according to Ballard, who predicts that by year's end there will be 10 to 20 important titles that will play—or at least play well—only on PCs using 3Dfx chips. "Early on, 3Dfx worked hard at getting software developers to support it, and since then there's just been a groundswell in the die-hard gamer community," says Dean McCarron, a market analyst at Mercury Research. "The amount of fan loyalty they've achieved at retail is incredible."

But it will take more than just gamers to keep 3Dfx growing. In addition to familiar competitors ATi, Matrox, nVidia, and S3, 3Dfx now faces a new nemesis in giant Intel, which released its 740 3D graphics chip this year. Another challenge for 3Dfx is that the market for acceleration cards could peak or even decline in the next few years, because many consumer PCs are already shipping with some 3-D capability.

3Dfx plans to advance to the next level by convincing PC makers that they should include the Voodoo2 3-D accelerator and new Voodoo Banshee 2-D/3-D accelerator chips from the start. Ballard even envisions a "Banshee on-Board" sticker on PCs, similar to Intel's successful branding campaign.

Although Compaq, Gateway, and Micron have already signed on, other manufacturers fighting to trim every dime off of costs could go with a cheaper solution, even though the Voodoo2 or Voodoo Banshee chip adds only a small fraction to a PC's total price.

Ballard remains confident. "We can make the sub-$1,000 PC much more attractive," he says. "Even at the extreme: Say you have a $599 computer that has no particularly interesting features. But you add a little bit of additional cost, so now it's a $649 computer with a Banshee in it. Put those two systems side by side and we believe you're going to sell a lot more of the $649 computer."

The PC would win a similar face-off against a dedicated game machine, says Ballard, who insists that the leading graphics hardware companies bring PC game performance far beyond that of video game players. "Voodoo2 has ten times the graphics performance of the Nintendo 64 and is farther beyond the Sony PlayStation," he says. "You can put the same titles side by side and it's not even close. If you're a real gamer, the center of the gaming universe is shifting over to the PC."

And the sweet spot of that bigger universe is the mainstream PC market, which 3Dfx plans to win with the right combination of marketing, technology, and software support. "Consumers don't care about bits and bytes," says Ballard. "They care about the entertainment experience, and that's what we're about."

And how does 3Dfx plan to keep its edge in the years ahead? Ballard's simple answer: "More. More power, more realism."—*DN*

to create true 3-D digital replicas of objects. The Carpinteria, California company, led by CEO Gary Lauer, posted 1997 revenues of $69.1 million.

59 Western Digital Corp.

www.wdc.com



At one time a leading maker of calculator chips, Western Digital was also one of the key architects of the IDE and Enhanced IDE standards. Today the company is a leader in the storage market, thanks in part to its popular Caviar line of hard disks. In addition to 3.5-inch Enhanced IDE drives for PCs, Western Digital makes high-capacity SCSI drives for workstations and servers. The Irvine, California company is also expanding into RAID systems and multimedia convergence products. Under chairman, president, and CEO Chuck Haggerty, the company's revenues reached $4.18 billion for the fiscal year that ended June 28, 1997.

60 Matrox Graphics Inc.

www.matrox.com/mgaweb



When its fiscal year 1998 ended March 31, the privately held Matrox Graphics, led by president Lorne Trottier, posted estimated one-year revenues of $690 million. With its recently introduced MGA-G100 and MGA-G200 chips, Matrox expects to expand its 33 percent share of the add-in branded board market. Sales of its 64-bit graphics accelerators, including the Matrox Millennium and Matrox Mystique, have grown over the past four years as the Montreal-based company utilized PCI architecture and implemented dual-ported WRAM in its products.

61 Sharp Corp.

www.sharp.co.jp/index-e.html



Led by president Katsuhiko Machida, Sharp and its U.S. subsidiary Sharp Electronics Corp. manufacture home and office electronics products. In addition to notebook PCs, the company makes a variety of handheld PCs, including the Zaurus and the Windows CE–based Mobilon. Sharp also makes flat-panel LCD monitors and anticipates increased development of advanced LCD technologies in the coming year. For the fiscal year that ended March 31, 1998, the Osaka, Japan–based company announced $13.70 billion in worldwide sales.

62 Fujitsu Ltd.

www.fujitsu.co.jp/index-e.html



Spun off from the communications division of Fuji Electric Co. in 1935, Fujitsu manufactures computers, telecommunications equipment, semiconductors, and a wide range of other electronic devices. In the U.S., the company makes printers, scanners, mass-storage products, and the LifeBook line of notebook computers. It is also a leader in plasma display technology, with its line of wide-screen color plasma displays. Led by CEO Tadashi Sekizawa, the Tokyo company had revenues of $37.77 billion for the fiscal year that ended March 31, 1998.

63 Hitachi Ltd.

www.hitachi.co.jp



Headed by CEO Tsutomu Kanai, Hitachi manufactures a wide range of electronic products, with an emphasis in the U.S. on consumer electronics, semiconductors, and computer products. One of the first companies to unveil a notebook computer based on the Pentium II chip, Hitachi recently announced a 2-pound handheld PC that boasts an 8.1-inch–diagonal color LCD. Hitachi also makes a variety of PC monitors, including the VisionDesk, a 13.3-inch flat-panel LCD. The Tokyo-based company reported total consolidated sales of $63.76 billion for the fiscal year that ended March 31, 1998.

64 ViewSonic Corp.

www.viewsonic.com

A supplier of high-performance computer monitors, the privately held ViewSonic has expanded its product line with flat-panel LCDs and its first LCD projector. In addition to products for the home and SOHO markets, the company makes professional monitors for CAD/CAM and graphic design. Under the leadership of founder and CEO James Chu, the Walnut, California company posted an estimated $830 million in 1997 revenues, a nearly 60 percent increase over 1996 revenues.

65 Sybase Inc.

www.sybase.com

Sybase is a developer of database management and applications development software, including PowerBuilder, a RAD environment, and PowerJ Enterprise, a Java development package. Sybase has been addressing some slippage in its market with a move into object-oriented databases. At the heart of Sybase's effort is its Adaptive line of database servers and the Jaguar Component Transaction System, a Java-based server application. Under co-CEOs Mitchell Kertzman and John Chen, the Emeryville, California company reported 1997 revenues of $903.9 million.

66 MCI Communications Corp.

www.mci.com

MCI was close to a $37 billion merger with U.S. carrier WorldCom at press time, a move that could prompt MCI for regulatory reasons to sell off assets related to its growing Internet efforts. Since launching InternetMCI in 1994, the Washington, D.C. communications giant has expanded its line of services to include Web site hosting and intranet services as well as nationwide dial-up Internet access. A major Internet backbone provider, MCI has further expanded its online presence through partnerships with Real Networks and Yahoo! Under the direction of CEO Gerald Taylor, MCI's 1997 revenues totaled $19.65 billion.

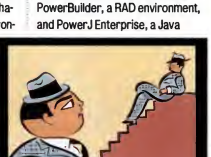
67 Motorola Inc.

www.motorola.com

Led by CEO Christopher B. Galvin, electronics and communications giant Motorola ended 1997 with $29.79 billion in revenues, a 6.5 percent increase over 1996. Motorola's 300-MHz 750 PowerPC chip is at the heart of Apple's Power Macintosh G3, which has tried to give 400-MHz Pentium II machines a run for their money. The Schaumburg, Illinois–based company recently introduced AltiVec, a multimedia acceleration technology that will be incorporated into its PowerPC chips. In addition to microprocessors, Motorola designs, manu-

RANK AND REVENUES

A high rank on the PC Magazine 100 doesn't necessarily mean high revenues, nor do high revenues always translate into a high rank.



COMPANY	RANK	REVENUES (1997)
Yahoo!	13	$67.4 million
Eastman Kodak	90	$14.5 billion


Do I want the best technology
money can buy, or the
best technology for the money?
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Direct from Compaq.

How did Compaq computers become the best selling in the world? By making the best technology easy to get. Take, for example, the Armada 1700. The first affordable, all-in-one notebook with the Mobile Intel® Pentium® II Processor. All the power you want, for less than you'd expect to pay. You can order by calling us directly or visiting our website. And don't forget to ask about our leasing options. Purchase technology the way that's best for you. Your way. What else would you expect from a leader like Compaq?



Armada 1700

The fully integrated notebook from Compaq that combines the latest key technology with uncompromising value.

$2,869[1]

- Mobile Intel Pentium II Processor @ 233 MHz; 512 KB L2 Cache
- 4.0 GB SMART Hard Drive[2]
- 32 MB SDRAM (expandable to 160 MB)
- 12.1" CTFT SVGA display
- 24X Max CD-ROM*; K56flex modem[3]
- Integrated AC Adapter
- New Multibay design allows for easy swapping of options including a second hard drive, second battery, SuperDisk LS-120, or Zip Drive
- 3-spindle design allows simultaneous access to multiple storage devices
- Optimized for use in a networked environment
- Intelligent Manageability features offer lower total cost of ownership
- Certified for multiple operating systems, including Windows NT® 4.0
- 1-year limited warranty[4]

Options for Armada 1700 Notebook

- Compaq Value Carrying Case: $49[1]
- Additional Li-Ion battery: $189[1]



Compaq Armada Notebooks

Armada 1505

The fully integrated notebook with everything you need in one convenient package.

$1,599[1]

- Intel Pentium Processor with MMX™ Technology @ 200 MHz; 512 KB L2 Cache
- 2.1 GB Hard Drive[2]
- 32 MB RAM (expandable to 96 MB)
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- 20X Max CD-ROM*; K56flex modem[3]
- Integrated AC Adapter
- NiMH battery
- Dual-bay design supports second battery
- 1-year limited warranty[4]

Armada 7800

The ultimate high-performance notebook delivering unprecedented desktop functionality and mobile convenience.

$5,549[1]

- Mobile Intel Pentium II Processor @ 266 MHz; 512 KB L2 Cache
- 8.0 GB SMART Hard Drive[2]
- 64 MB SDRAM (expandable to 256 MB)[3]
- 14.1" CTFT (1024 x 768) display
- 24X Max CD-ROM*; 33.6 Kbps Telephony modem
- Integrated AC Adapter
- Powerful AGP graphics allow for superior graphics while on the road or in the office
- Multibay design allows for easy swapping of options including a second hard drive, second battery, SuperDisk LS-120, or future DVD drive
- 3-year limited warranty[4]

Options for Armada 7000 Notebooks

- ArmadaStation Expansion Base for full desktop functionality: $779[1]
- ArmadaStation Tower Stand: $99[1]
- Compaq Briefcase: $99[1]

Common features of Armada Series

- Optimized for use in a networked environment
- Intelligent Manageability features offer lower total cost of ownership
- Certified for multiple operating systems, including Windows NT 4.0

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Compaq Deskpro EP Series

Small Business Deskpro Solutions

These Compaq product bundles have been designed specifically for growing businesses. They come pre-installed with Microsoft® Internet Explorer® 4.0, Norton AntiVirus 4.0 and INEX Commerce Court Publisher.

Model 6266/2100/CDSM

$1,459[1]

- Intel® Celeron™ Processor @ 266 MHz
- 2.1 GB SMART II Ultra ATA Hard Drive[2]
- 32 MB SDRAM
- ATI RAGE IIC AGP Graphics
- 24X Max CD-ROM*; K56flex modem[3]
- Microsoft Word 97
- Compaq Microsoft IntelliMouse™
- Compaq V75 17" (16" viewable) monitor
- 3-year limited warranty[4]

Model 6300/4300/CDSM

$1,869[1]

- Intel Pentium II Processor @ 300 MHz
- 4.3 GB SMART II Ultra ATA Hard Drive[2]
- 32 MB SDRAM
- ATI RAGE IIC AGP Graphics
- 24X Max CD-ROM*; K56flex modem[3]
- Microsoft Office 97 Small Business Edition
- Compaq Microsoft IntelliMouse
- Compaq V75 17" (16" viewable) monitor
- 3-year limited warranty[4]

Options for Deskpro EP Series

- Additional 32 MB SDRAM Memory: $139[1]
- Upgrade to Compaq V90 Monitor: $349[1]
- SuperDisk LS-120 Drive: $129[1]
- Compaq C-Series 810 Handheld: $599[1]



Compaq Armada SB

Small Business Notebook Solution

The notebook designed specifically for small businesses to provide out-of-the-box productivity combined with affordable high performance.

Armada SB Notebook

$2,099[1]

- Intel Pentium Processor with MMX Technology @ 200 MHz
- 3.2 GB SMART Hard Drive[2]
- 32 MB EDO RAM (expandable to 96 MB)
- 12.1" CSTN SVGA display
- 20X Max CD-ROM*; K56flex modem[3]
- Microsoft Office 97 Small Business Edition included for out-of-the-box productivity
- Integrated AC Adapter
- 3-spindle design allows simultaneous access to multiple storage devices
- Dual-bay design supports a second battery for even greater power while on the road
- Optimized for use in a networked environment
- Intelligent Manageability features offer lower total cost of ownership
- Certified for multiple operating systems
- 1-year limited warranty[4]

Options for Armada SB

- Additional 32 MB SDRAM Memory: $115[1]
- Enhanced Smart NiMH Battery: $99[1]



Compaq ProSignia 200 6/300

Small Business Server Solution

An integrated turnkey solution for small businesses needing inexpensive file/print, communications or database capabilities and bulletproof server reliability without the overhead cost of in-house technical expertise.

ProSignia 200 6/300 Small Business Server With a FREE V55 Monitor[7]

$4,719[1]

- Intel Pentium II Processor @ 300 MHz
- 4.3 GB Wide-Ultra SCSI-3 enterprise-class hard disk[2]
- 64 MB ECC Memory (upgradable to 384 MB)[5]
- 4/8 GB SLR enterprise-class tape drive
- K56flex modem[3]
- Pre-installed Microsoft BackOffice® for Small Business Server including up to 10 user clients; Insight Agent Events Notification Tool monitors and reports potential server issues
- Extend your business to the Internet, either locally or through an Internet service provider
- Back up and protect your business data easily
- Efficiently share data and devices such as printers and modems
- 3-year on-site limited warranty[6]
- For a limited time, free Compaq V55 15" (13.7" viewable) monitor[7] with 1-year limited warranty[4]

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Compaq Deskpro EP Series

The business computer for those who crave the latest industry-standard technologies, at very aggressive pricing.

Model 6266X/3200

$1,509[1]

- Intel Pentium II Processor @ 266 MHz
- 3.2 GB SMART II Ultra ATA Hard Drive[2]
- 32 MB SDRAM
- ATI RAGE IIC AGP Graphics
- Compaq V75 17" (16" viewable) monitor
- Towerable chassis converts from desktop to minitower
- 3-year limited warranty[4]

Model 6333/3200/CDS

$1,929[1]

- Intel Pentium II Processor @ 333 MHz
- 3.2 GB SMART II Ultra ATA Hard Drive[2]
- 32 MB SDRAM
- ATI RAGE IIC AGP Graphics
- 24X Max CD-ROM[4]
- Compaq V75 17" (16" viewable) monitor
- Towerable chassis converts from desktop to minitower
- 3-year limited warranty[4]

Model 6350X/6400/CDS

$2,139[1]

- Intel Pentium II Processor @ 350 MHz
- 6.4 GB SMART II Ultra ATA Hard Drive[2]
- 64 MB SDRAM
- ATI RAGE PRO TURBO AGP Graphics
- 24X Max CD-ROM[4]
- Compaq V75 17" (16" viewable) monitor
- Towerable chassis converts from desktop to minitower
- 3-year limited warranty[4]

Model 6400X/6400/CDS

$2,269[1]

- Intel Pentium II Processor @ 400 MHz
- 6.4 GB SMART II Ultra ATA Hard Drive[2]
- 64 MB SDRAM
- ATI RAGE PRO TURBO AGP Graphics
- 24X Max CD-ROM[4]
- Compaq V75 17" (16" viewable) monitor
- Towerable chassis converts from desktop to minitower
- 3-year limited warranty[4]

Deskpro EP 6266X/2100

$1,299[1]

- Intel® Celeron™ Processor @ 266 MHz
- 2.1 GB SMART II Ultra ATA Hard Drive[2]
- 16 MB SDRAM
- ATI RAGE IIC AGP Graphics
- Compaq V75 17" (16" viewable) monitor
- Towerable chassis converts from desktop to minitower
- 3-year limited warranty[4]

Options for Deskpro EP Series

- Additional 32 MB SDRAM Memory: $139[1]
- Upgrade to Compaq V90 Monitor: $349[1]
- SuperDisk LS-120 Drive: $129[1]
- Compaq C-Series 810 Handheld: $599[1]

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intel inside pentium II

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factures, and distributes a wide variety of products, including cellular phones, modems, pagers, microcontrollers, and digital signal processors.

68 3Dfx Interactive Inc.

www.3dfx.com

3Dfx Interactive's products are buried deep inside the PC, but the impact they've made is as plain as the high-quality graphics they help produce. The San Jose, California company's 3-D accelerator chip is used in such popular graphics cards as the Canopus Pure 3D, Creative Labs 3D Blaster Voodoo2, and Diamond Monster 3D II. PC gamers have helped the company post $44.1 million in 1997 revenues, but CEO Greg Ballard plans to move the company into mainstream computing in the coming year. (See the sidebar "More than Just Fun and Games.")

69 Logitech International SA

www.logitech.com

Founded in 1981 by two European computer-engineering students studying at Stanford, Logitech is now one of the world's top producers of mice and other computer input devices. The Swiss company posted $390.2 million in revenues for the fiscal year that ended March 31, 1998. Under the direction of newly appointed CEO Guerrino De Luca, Logitech designs, manufactures, and markets its line of Senseware Peripherals, which include mice, trackballs, touch pads, digital video cameras, joysticks, and game pads. Logitech recently merged its line of personal scanners with Storm Technology to pursue its input device business more aggressively.

70 Inprise Corp.

www.inprise.com

Inprise changed its name from Borland in April 1998, and it continues to mount a turnaround strategy in Scotts Valley, California, under CEO Delbert Yocam. Inprise changed its financial reporting to reflect a calendar year instead of a fiscal year, resulting in a $65.5 million loss in 1997, which included only three financial quarters. Well known for its dBASE database products, the company has also succeeded with its Delphi Client/Server Suite, a visual rapid applications development environment, and JBuilder, a Java development tool. Inprise completed its acquisition of Visigenic, a provider of CORBA distributed object technology.

71 Broderbund Software Inc.

www.broderbund.com

Since its founding in 1980 by brothers Doug and Gary Carlston, Broderbund has grown to become one of the leading producers of home-use and educational software with products such as Family Tree Maker, Print Shop, and the Carmen Sandiego series. Broderbund's Red Orb division publishs entertainment titles, including Myst and its sequel Riven, the best-selling game of 1997. Led by CEO Joe Durrett, the Novato, California–based company posted revenues of $190.8 million for the fiscal year that ended August 31, 1997. In June 1998, Broderbund reached a definitive merger agreement with The Learning Company.

72 PointCast Inc.

www.pointcast.com

Having successfully weathered the "push technology" backlash of the past year, PointCast emerged as the largest privately held media company on the Internet and online news provider to corporations. The PointCast client/server broadcast now handles more than 120 million hits a day and offers a collection of 600 leading business sources. CEO David Dorman reported that PointCast increased its viewership by 50 percent in 1997 to 1.2 million, which allowed it to increase its advertising base. The Sunnyvale, California–based company, which had 1997 revenues of $18 million, recently canceled plans for an initial public offering.

73 Gartner Group Inc.

www.gartner.com

Gartner Group is an independent provider of research and analysis for computer hardware, software, communications, and related IT industries. Grabbing the attention of CIOs with its now-infamous "total cost of ownership" report, Gartner Group has expanded still further in this arena with its recent acquisition of Interpose, a provider of TCO software tools. The Stamford, Connecticut–based company also owns Datapro information Services and market intelligence firm Dataquest. Under CEO Manuel A. Fernandez, the company posted $511.2 million in revenues for the fiscal year that ended September 30, 1997.

74 Cabletron Systems

www.cabletron.com

New CEO Craig Benson took over control of Cabletron after Donald Reed resigned in March 1998. Although Cabletron continues to produce Internet and Intranet hardware and management solutions, it also focuses on the nascent realm of single-system data, voice, and video convergence. Cabletron has announced a trio of acquisitions—Digital's Network Business division, Gigabit Ethernet, and YAGO Systems—to expand the company further. The Rochester, New Hampshire company posted revenues of $1.38 billion for the fiscal year that ended February 28, 1998.

75 PC Connection Inc.

www.pcconnection.com

Founded 16 years ago by David Hall and current CEO Patricia Gallup, PC Connection is a direct marketer of PCs, peripherals, accessories, and networking products to the business, education, government, and home markets. The company's emphasis on customer service led it to be one of the early adopters of toll-free technical support and overnight delivery for its products. The Milford, New Hampshire company made its initial public offering of common stock in March 1998 after posting $550.6 million in 1997 revenues.

76 Activision Inc.

www.activision.com

Activision was the one of the first independent developers and distributors of entertainment software. The company now offers titles that include such best-sellers as MechWarrior II, Pitfall, Quake II, and Infocom's Zork series. Led by CEO Robert Kotick, Activision continues to offer groundbreaking software titles that utilize



CHANGES AT THE TOP

17 companies on the PC Magazine 100 have changed CEOs since last year's list came out.

Apple, AT&T, Cabletron, Informix, Intel, Iomega, Lexmark, Logitech, Macromedia, Matsushita, PointCast, Samsung, The Santa Cruz Operation, SAP, Sharp, Silicon Graphics, and S3.

the most current technologies. The Santa Monica, California company posted revenues of $259.9 million for the fiscal year that ended March 31, 1998, and revised its statement of 1997 earnings to $154.6 million from the previously reported $86 million.

77 Cirrus Logic Inc.

www.cirrus.com

After reducing its development cycle time and joining forces with IBM to produce semiconductor wafers, integrated circuit manufacturer Cirrus Logic posted $954.3 million in revenues for the fiscal year that ended March 28, 1998. CEO Michael L. Hackworth is leading a product operations realignment into four market-focused divisions. The company's architectural transitions included a move to the FastPath modem platform and the SoundFusion audio platform. Cirrus also began shipments of its new high-speed 56K modem chip sets.

78 Asymetrix Learning Systems Inc.

www.asymetrix.com

CEO James A. Billmaier last year oversaw the purchase of Asymetrix's closest competitor, Aimtech, to form the largest remote-learning and multimedia development company in the arena. The new Asymetrix now has the combined resources of Asymetrix's CBT development tools and remote-learning management systems as well as Aimtech's multimedia development programs, including the IconAuthor series. Numerous government and Fortune 500 contracts for remote-learning services helped propel the Bellevue, Washington company to 1997 revenues of $24.1 million.

79 Quarterdeck Corp.

www.quarterdeck.com

Diagnostic and system maintenance software maker Quarterdeck posted $83.8 million in revenues for the fiscal year that ended September 30, 1997, a 37 percent decline from fiscal 1996. The company is best known for its disk management software CleanSweep, troubleshooting products Fix-It and TuneUp, and Internet software WebCompass. Quarterdeck's worldwide presence has increased as a result of its Web-based PC diagnostic and maintenance service, TuneUp.com. Based in Marina Del Ray, California, the company is led by interim president King Lee following the resignation of president and CEO Curt Hessler in July 1998.

80 Philips Electronics NV

www.philips.com

From LCD projectors and PC monitors to integrated circuits and speech-processing products, Philips Electronics plays a diverse role in the computer industry. Based in Eindhoven, the Netherlands, Philips cointroduced the CD-ROM with Sony and since then has had a leading role in authoring standards for the industry. The company is also in a continuing venture with Sony to produce the next generation of audio CDs. A pioneer of CD-R technology, Philips continues to lead the field with CD-RW and DVD-ROM players. Headed by CEO Cor Boonstra, Philips posted 1997 revenues of $39.21 billion.

81 Informix Software Inc.

www.informix.com

Database software developer Informix is battling rival Oracle in the object/relational arena by extending its flagship Informix Dynamic Server with a Universal Data Option. After a turbulent year that included a problematic audit, Robert Finocchio was appointed as the new CEO of the Menlo Park, California company. With 1997 revenues of $662.3 million, Informix has begun to strengthen its position in the database market.

82 Quantum Corp.

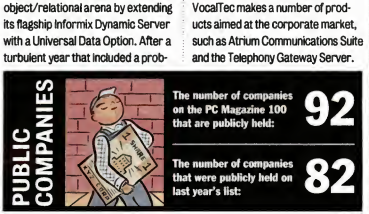
www.quantum.com

A manufacturer of hard disks, Quantum was founded in 1980 as a storage maker for PC companies and resellers. The Milpitas, California company saw fast growth in the 1990s and entered the retail sector in 1996. With its own research and development group for ASIC technology, Quantum now makes a wide variety of disk types, including IDE, SCSI, solid-state, and Fibre Channel. Committed to a strategy of fast time-to-market, Quantum posted revenues of $5.81 billion for the fiscal year that ended March 31, 1998, under CEO Michael A. Brown.

83 VocalTec Communications Ltd.

www.vocaltec.com

VocalTec introduced the world to free long-distance voice communication in 1995 with a package called Internet Phone. Although Internet telephony is still in its infancy, the Israeli company continues to grow rapidly. Under CEO Elon A. Ganor, VocalTec posted 1997 revenues of $15.7 million, an increase of 85 percent over 1996. In addition to its consumer-oriented Internet Phone, VocalTec makes a number of products aimed at the corporate market, such as Atrium Communications Suite and the Telephony Gateway Server.



84 Lexmark International Inc.

www.lexmark.com

Ever since it was spun off from IBM in 1991, Lexmark has been a major player in the printer market. One of the first companies to manufacture a true 1,200-dpi printer, Lexmark makes laser and inkjet printers for both home and office markets as well as printer management software for servers. The Lexington, Kentucky company posted $2.49 billion in 1997 revenues, 55 percent of which came from sales outside the U.S. Under newly appointed CEO Paul Curlander, Lexmark plans to expand its business with specialized industry-specific printers.

85 SAP AG

www.sap.com

The world's fourth-largest independent software supplier, SAP (Systems, Applications and Products in Data Processing) posted $3.36 billion in 1997 revenues. Based in Walldorf, Germany, the company saw an increase in the sale of its client/server management software R/3, thanks to the worldwide concern about the year-2000 problem. Sharing the office of CEO, Henning Kagermann and Hasso Plattner plan to win new customers for SAP by moving into new markets with R/3-based products and the recent release of R/3 Version 4.0, which can be tailored to specific industries.

86 Samsung Electronics Co. Ltd./AST Research Inc.

www.samsung.com, www.ast.com

Samsung Electronics, one of the 30 companies in the Korea-based Samsung Group, manufactures a wide range of products that include notebook PCs, monitors, semiconductors, home appliances, audio equipment, and wireless communication products. The company also

@Home

Fast Growth, Fast Friends

97

Although pundits debated the merits of AT&T's multibillion-dollar buyout of cable giant TCI this summer, the deal was clearly a boost for @Home Network, the pioneer provider of fast Internet connections via cable hookups. TCI has a 39 percent investment in @Home, which can now count on the vast resources of AT&T to supercharge its cause.

Cable companies Cox Communications and Comcast also own pieces of @Home. "We like to think that @Home is starting to get broadly known, but let's face it, AT&T is one of the world's largest consumer brands and has 80 million customers," says @Home CEO Tom Jermoluk. "Our goal is to leverage that."



@Home CEO Tom Jermoluk plans to bring speedy cable modem connections to millions of Internet users in the next five years.

With a relatively low $700,000 in 1996 revenues, @Home posted the largest revenue increase on the PC Magazine 100—a more than tenfold increase to $7.4 million in 1997 that helped land the company in the number-97 spot on the list. The 18 affiliate agreements with cable companies including Cablevision, Comcast, and TCI also helped.

The affiliates make the @Home service available to some 60 million homes. Just over 147,000 users had signed up as of July, a far cry from the aggressive forecasts the company made after it was founded in 1995. But with the support of AT&T and growing consumer interest in a faster Internet experience, @Home is set to take off. Jermoluk expects to sign up millions of @Home customers in the next five years.

"The scope of what we can offer has changed from being just an Internet browser on a cable modem in 1995," says Jermoluk. At speeds up to 100 times as fast as a dial-up connection, @Home smoothes out the herky-jerky video quality of most dial-up connections to something more akin to—well, cable TV. CNN and Bloomberg already provide videos to @Home users, and more content providers will follow. "People use this stuff because it's fast," says Jermoluk.

@Home uses its high-speed fiber-optic backbone to offer what most dial-up connections can't: CD-quality audio, sports talk and concerts, a multiplayer gaming network, and Software Now, which lets users test, rent, and purchase software products.

The @Home service has major competition on at least two fronts: Time Warner's RoadRunner cable modem service and a competing technology called ADSL from the Regional Bell Operating Companies (RBOCs). "ADSL is a good technology," Jermoluk says. In fact, @Home plans to use a variant of the technology, DSL, for its newer @Work, a high-speed Internet access service for businesses, where it can't provide cable connections.

Meanwhile @Home has priced its service to compete with dial-up connections and has established a standard with 20 companies that are providing @Home-compatible modems. The @Home service costs about $40 per month for cable customers, plus a one-time installation fee as low as $50 with rebates or promotions.

The PC will not be the only place for @Home. Jermoluk envisions a range of devices, starting with televisions, to be included. For example, @Home's service will be offered as part of an advanced set-top box the company is developing with Microsoft and Sun for TCI.

Instead, @Home plans a variety of one-click services, such as the ability to order from an on-screen ad or to get more information about the product. "Or say you're watching a football game and you can make a videophone connection to a friend in the corner of the screen," says Jermoluk. "How'd you like to be laughing with your buddy on-screen in another city after a great play, and say 'Man, did you see that!'"—*DN*

makes microprocessors through its newly established Alpha Processor division. Led by recently appointed CEO Kun-Hee Lee, Samsung Electronics posted $13 billion in 1997 revenues. AST Research, one of Samsung Electronics' subsidiaries, is a well-known manufacturer of notebook and desktop PCs and servers. Under CEO Soon-Taek Kim, AST Research posted estimated 1997 revenues of $2.1 million.

87 Phoenix Technologies Ltd.

www.phoenix.com

Just under 20 years old, Phoenix Technologies is a supplier of the system BIOS software that is integral to most Intel-based PCs' compatibility. Despite a rocky period at the start of the decade, Phoenix has persevered to hold more than 40 percent of the PC BIOS market. Last year marked new releases of PhoenixBIOS and NoteBIOS, its PC and notebook products, as well as expansion into PICO products used in handheld PCs. The San Jose, California company brought in $82.1 million in revenues for the fiscal year that ended September 30, 1997, under CEO Jack Kay.

88 Dragon Systems Inc.

www.dragonsystems.com

Privately held Dragon Systems is a leader in speech and language technology. Since the company's inception, cofounder and CEO James Baker has sought to humanize the interface between people and machines through speech recognition software. Dragon Systems' NaturallySpeaking, for example, allows the user to speak naturally and continuously, and the words are reproduced in text on the screen. The Newton, Massachusetts company, which had estimated 1997 revenues of $30 million, plans to launch several research projects in the areas of machine-assisted translation and high-noise adaptation.

89 Number Nine Visual Technology Corp.

www.nine.com

Number Nine entered the market in 1982 with the first CPU accelerator board for the Apple II and kept up the pace through the 1980s with products for Intel-based PCs. In 1994, it released one of the first 128-bit graphics engines. Slow to adopt the latest 3-D innovations, however, the Lexington, Massachusetts company posted $47.2 million in 1997 revenues, a 60 percent decline from 1996. But founder and CEO Andrew Najda is fighting back with 2-D business products and high-end 3-D accelerators for gaming, graphics design, and full-motion video.

90 Eastman Kodak Co.

www.kodak.com

With its motto of "Take Pictures. Further," Kodak is intent on moving photography into the next millennium. In 1997, the company continued aggressively expanding and developing its line of digital imaging products such as scanners, photo CDs, digital cameras, and digital projectors. The recently announced Kodak DC200, one of the first available sub-$1,000 megapixel digital cameras, offers quality very close to that of a regular camera. Led by CEO George M.C. Fisher, the Rochester, New York company recorded $14.54 billion in 1997 revenues, a 9 percent increase over 1996.

91 DeLorme Mapping Co.

www.delorme.com

It wasn't until the mid-eighties that the publisher of the *Maine Atlas and Gazetteer* entered the computer mapping field. Today, with an estimated $36.2 million in 1997 revenues, DeLorme is a top software publisher, offering such staples as AAA Map'n'Go, Phone Search USA, and Street Atlas USA. In 1996, the privately held DeLorme produced its first hardware product, Tripmate, a global positioning system receiver. Located in Yarmouth, Maine, DeLorme is headed by CEO David DeLorme.

92 Quark Inc.

www.quark.com

Privately held Quark has set the standard for professional-level electronic publishing. Though its popular publishing software QuarkXPress remains a staple, the Denver company is focusing on products that will keep it in tune with new media expectations. This has been done through new partnerships and mergers such as the acquisition of mFactory, which added multimedia authoring tool mTropolis to its product line. Led by CEO Fred Ebrahimi, Quark posted estimated 1997 revenues of more than $200 million.

93 CIDCO Inc.

www.cidco.com

Founded as "The Caller ID Company" in 1988, telecommunications company CIDCO has branched out from its initial focus on advanced telephone products. Amid much hype about Internet appliances, the Morgan Hill, California company was one of the first to get one to the market. The CIDCO iPhone features full Internet access along with advanced telephony functions in a device not much larger than a standard phone. Under the direction of president and CEO Daniel L. Eilers, the company posted 1997 revenues of $257 million.

94 PeopleSoft Inc.

www.peoplesoft.com

PeopleSoft combines enterprise applications for finance, materials management, distribution, manufacturing, and human resources into a single computing environment. CEO David Duffield plans to continue to go after the global market with features such as European payroll capabilities, support for the European Economic and Monetary Union, and support for IBM's AS/400 platform. The Pleasanton, California company posted 1997 revenues of $815.7 million.

95 The Santa Cruz Operation Inc.

www.sco.com

The Santa Cruz Operation supplies Unix server operating systems, providing products capable of supporting multiple client types. Now led by newly appointed CEO Douglas Michels, the Santa Cruz, California company posted $193.7 million in revenues for the fiscal year that ended September 30, 1997. Recently, it combined its UnixWare and Open Server Unix into one integrated operating system and released Tarantella, which allows Unix-based applications to run on Java clients without being re-coded.

96 Rockwell Semiconductor Systems

www.nb.rockwell.com

Rockwell Semiconductor Systems, led by president Dwight W. Decker, saw its modem chip sets appear in two-thirds of all the modems connecting to the Internet in 1997. The Newport Beach, California company also manufactures chip sets for cellular and cordless telephones, PC-based videoconferencing systems, fax machines, and high-speed communications systems. Parent company Rockwell International, with 1997 revenues of $7.76 billion, could soon spin off Rockwell Semiconductor.

97 @Home Network

www.home.net

Working to deliver the promise of fast cable-television connections to the Internet, @Home Network

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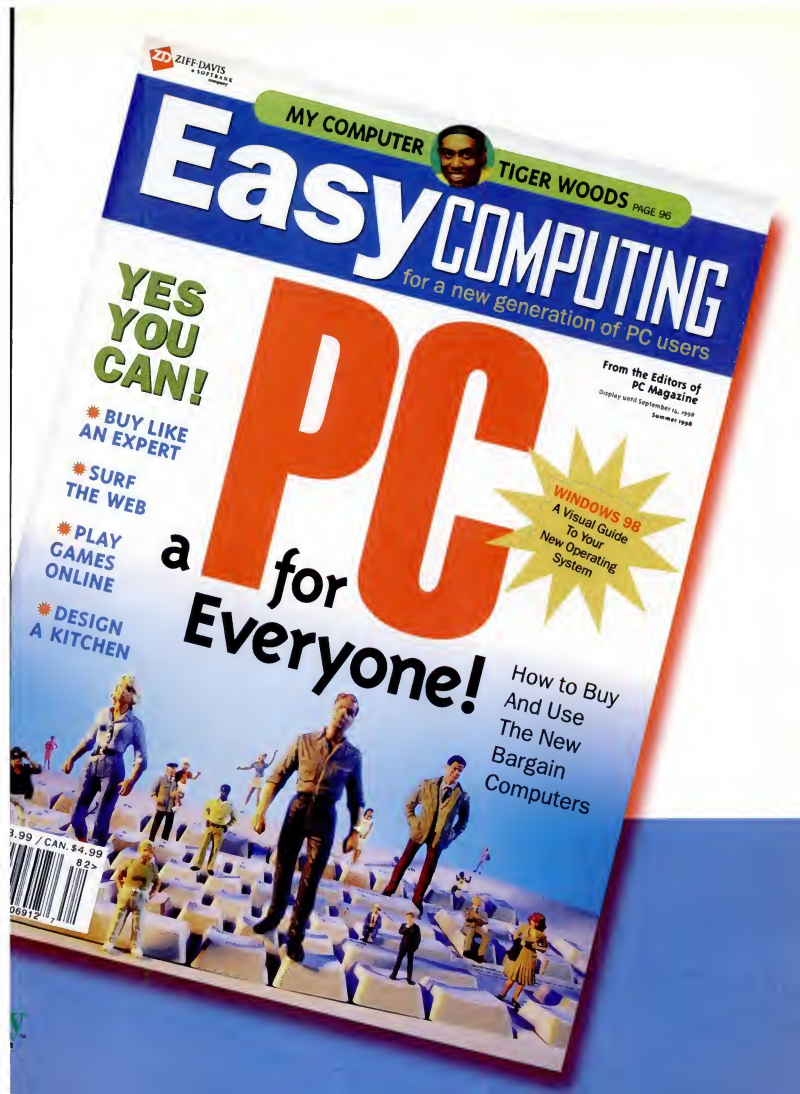
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has constructed a system that provides cable modem users with Web connections that are hundreds of times as fast as traditional telephone modems. The Redwood City, California company posted 1997 revenues of $7.4 million under the direction of CEO Thomas A. Jermoluk. (See the sidebar "Fast Growth, Fast Friends.")

98 In Focus Systems Inc.

www.infocus.com



In Focus Systems manufactures multimedia projection systems and LCD projection panels. The Wilsonville, Oregon company makes fixed installation systems for large auditoriums and midsize products for conference rooms as well as portable products for the road. It recently introduced the In Focus LP420, a lightweight projector that uses digital light processing to produce images on a par with projectors twice as big. Through its subsidiary Genigraphics, In Focus also offers such consulting services as presentation development. Under the direction of CEO John V. Harker, In Focus posted revenues of $315.8 million in 1997.

99 The Learning Company Inc.

www.learningco.com

Best known as a developer of education, lifestyle, and productivity software, The Learning Company has pushed still further into the education market with its acquisitions of Creative Wonders, Mindscape, and Skills Bank. Through its purchase of Microsystems Software (the maker of Cyber Patrol software), the Cambridge, Massachusetts company has also become a player in Internet filtering technology. Under the direction of CEO Michael Perik, The Learning Company has expanded into direct marketing with its acquisition of Learning Services, a marketer of school software to teachers. The Learning Company had revenues of $392.4 million in 1997, and in June, 1998 it reached a definitive merger agreement with Broderbund.

100 Computer Discount Warehouse Computer Centers Inc.

www.cdw.com

Founded in 1984 as a one-man home-based retailing business by CEO Michael Krasney, Computer Discount Warehouse Computer Centers is now one of the largest direct marketers of personal computers and computer-related products to business, education, government, and the home. One of the top ten catalogers in the world, CDW also has a massive storefront on the Web, which offers advanced product comparisons and automatic price and availability alerts. The Vernon Hills, Illinois–based company posted 1997 revenues of $1.28 billion, an increase of 38 percent over 1996.

Our Contributors:
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Compaq Entrepreneur Solutions offer small and medium businesses a variety of integrated solutions to help increase productivity while minimizing costs. Whether you need to add one computer, build an entire network, or develop your company's website, Compaq desktops, notebooks, and servers — configured specifically for growing businesses — provide an optimized combination of cutting-edge technology and preinstalled software tools. So you get everything you need in one convenient package.

Our all-in-one pricing, performance, and productivity software solutions help lower your cost of ownership. And with our industry-leading providers, we ensure that your technology evolves with your needs.

COMPAQ ENTREPRENEUR SOLUTIONS

A comprehensive desktop and software solution that leverages your resources.

The Compaq Deskpro EP Series, Small Business Solutions desktop is a cutting-edge solution for growing businesses*. It has the industry-leading hardware you demand to stay competitive. Plus a selection of software productivity tools to maximize your time and budget. The towerable form factor even lets you transform the desktop to fit your work space.

Deskpro EP Series 6266X/2100/0KB L-2 cache/CDS (32MB)

- 266MHz Intel® Celeron™ Processor with 66MHz Front Side Bus
- 32MB SDRAM and 2.1GB SMART II Ultra ATA Hard Drive
- ATI RAGE IIC AGP 64-bit Graphics Controller with 2MB EDO RAM
- V75 color monitor
- 24X[1] Max CD-ROM
- Compaq Microsoft IntelliMouse
- K56flex[2] data/fax modem
- Preinstalled Microsoft Windows 95, Microsoft Word® 97, Microsoft Internet Explorer 4.0, Norton AntiVirus® 4.0, and INEX Commerce Court Publisher**
- 3-Year Limited Warranty[3]

$1,359* or lease for $46/mo.[4]

Deskpro EP Series 6266X/4300/CDS (32MB)

- 266MHz Intel Pentium® II Processor with 66MHz Front Side Bus
- 32MB SDRAM and 4.3GB SMART II Ultra ATA Hard Drive
- ATI RAGE IIC AGP 64-bit Graphics Controller with 2MB EDO RAM
- V75 color monitor
- 24X[1] Max CD-ROM
- Compaq Microsoft IntelliMouse
- K56flex[2] data/fax modem
- Preinstalled Microsoft Windows 95, Microsoft Office 97 Small Business Edition, Microsoft Internet Explorer 4.0, Norton AntiVirus 4.0, and INEX Commerce Court Publisher**
- 3-Year Limited Warranty[3]

$1,649* or lease for $55/mo.[4]
$1,719* or lease for $58/mo.[4] with 300MHz Pentium II Processor

Deskpro EP Series 6350X/6400/CDS (64MB)

- 350MHz Intel Pentium II Processor with 100MHz Front Side Bus
- 64MB SDRAM and 6.4GB SMART II Ultra ATA Hard Drive
- ATI RAGE PRO TURBO AGP 64-bit Graphics Controller with 4MB SGRAM
- V75 color monitor
- 24X[1] Max CD-ROM
- Compaq Microsoft IntelliMouse
- K56flex[2] data/fax modem
- Preinstalled Microsoft Windows 95, Microsoft Office 97 Small Business Edition, Microsoft Internet Explorer 4.0, Norton AntiVirus 4.0, and INEX Commerce Court Publisher**
- 3-Year Limited Warranty[3]

$1,999* or lease for $67/mo.[4]
$2,119* or lease for $71/mo.[4] with 400MHz Pentium II Processor



*See pages 8 and 9 of this advertisement for available enhancements and upgrades.
**Retail software packages not included. Software shown is prebundled and will come with limited user documentation.

To order, visit **www.directplus.compaq.com/pcmc** Or call **1-800-888-5905**

A powerful, fully integrated portable solution with out-of-the-box productivity.

The Armada SB notebook is a powerful, flexible solution for all your business needs. It combines industry-leading hardware with a dynamite software suite — which means you can get even more out of your budget. It has everything you need — including an integrated modem, CD-ROM drive, and AC adapter — to keep you productive on the road.



Armada SB/200MHz

- 200MHz Intel Pentium Processor with MMX™ Technology
- 32MB memory and 3.2GB SMART Hard Drive
- 12.1" display with dual scan technology (CSTN) for vivid, high-contrast viewing
- Integrated K56flex² modem, 20X[6] Max CD-ROM, and AC adapter
- Optional Convenience Base for Ethernet connectivity
- NiMH Battery, DualBay design can support 2 batteries
- Preinstalled Microsoft Office 97 Small Business Edition software*
- Norton AntiVirus 4.0*
- 1-Year Limited Warranty[3]

$1,919* or lease for $64/mo.[4]

Armada SB/233MHz

- 233MHz Intel Pentium Processor with MMX Technology
- 32MB memory and 4.0GB SMART Hard Drive
- 12.1" CTFT display
- Integrated K56flex² modem, CD-ROM, and AC Adapter
- Optional Convenience Base for Ethernet connectivity
- Lithium Battery, DualBay design: supports 2 batteries for additional battery life
- Preinstalled Microsoft Office 97 Small Business Edition software*
- Norton AntiVirus 4.0*
- 1-Year Limited Warranty[3]

$2,299* or lease for $77/mo.[4]

**Retail software packages not included. Software shown is preloaded and will come with limited user documentation.*

ProSignia 200 Small Business Server

Easy to own, set up, and manage, so your server's ready for business when you are.

The Compaq ProSignia 200 Small Business Server is a complete solution for growing businesses that require low-cost file/print, database, and communications capabilities. Everything is preinstalled to get you up and running quickly. Robust hardware/software integration provides bulletproof reliability. So even with minimal IT resources, you get maximum uptime.

ProSignia 300MHz Server

- 300MHz Intel Pentium II Processor
- 64MB ECC upgradable to 384MB ECC
- 4.3GB Wide UltraSCSI Hard Drive
- 4/8GB SLR Tape Drive (internal)
- 16X Max CD-ROM Drive
- V55 Color Monitor
- 56Kflex[2] fax modem
- Preinstalled Microsoft Backoffice® Small Business Server software with 10-client license includes: Windows NT Server® 4.0, Internet Information Server[2], SQL Server,[2] Exchange Server,[2] FrontPage® 97, Proxy Server,[2] Small Business Server Console,[2] Outlook, Modem Sharing Software,[2] Internet Connection Wizard,[2] and FAX Server[2]*
- Compaq SmartStart for easier server setup
- Compaq Insight Manager® pages you or an authorized hardware service provider about issues before they become critical
- Cost-effective solution for maximum integration and expandability
- 3-Year Limited Warranty[3]

$4,719[1] or lease for $158/mo.[1]

*Retail software packages not included. Software shown is prebundled and will come with limited user documentation.



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For excellent flexibility, get the new Compaq Deskpro EP Series — the towerable CPU.

The Compaq Deskpro EP Series offers long-term value and flexibility in both standalone desktop and networked environments. It provides excellent price/performance and maximum reliability to meet a broad range of customer requirements. And it features a unique design that lets you easily transform it from a desktop to minitower.

- Power and performance — when space is limited but your requirements aren't
- Versatile towerable design lets you switch from desktop to minitower in minutes (see page 13)
- Up to 256MB or 384MB of SDRAM memory for superior performance



- Intel Celeron 266MHz processor or Pentium II processors from 266 to 400MHz
- Choice of 66MHz or 100MHz system bus (see pages 14 and 15)
- Fast ATI RAGE IIC or ATI RAGE PRO TURBO Graphics Controller with AGP support

Deskpro EP Series 66MHz Bus

	6266X	6266X	6266X	6300X/CDS	6333X/CDS
Bus	66MHz	66MHz	66MHz	66MHz	66MHz
Processor	Celeron 266MHz	Celeron 266MHz	Pentium II 266MHz	Pentium II 300MHz	Pentium II 333MHz
Std./Max. Memory	16MB/256MB SDRAM	32MB/256MB SDRAM	32MB/256MB SDRAM	32MB/256MB SDRAM	32MB/256MB SDRAM
SMART II Hard Drive	2.1GB Ultra ATA	3.2GB Ultra ATA	3.2GB Ultra ATA	3.2GB Ultra ATA	3.2GB Ultra ATA
Secondary Cache	0KB	0KB	512KB	512KB	512KB
Video Graphics	ATI RAGE IIC AGP	ATI RAGE IIC AGP	ATI RAGE IIC AGP	ATI RAGE IIC AGP	ATI RAGE IIC AGP
Video Memory/Max.	2MB EDO RAM/2MB	2MB EDO RAM/2MB	2MB EDO RAM/2MB	2MB EDO RAM/2MB	2MB EDO RAM/2MB
Total Slots/Bays	6/5	6/5	6/5	6/5	6/5
Compaq Color Monitor	V75 16" viewable	V75 16" viewable	V75 16" viewable	V75 16" viewable	V75 16" viewable
Diskette Drive	3.5" 1.44MB	3.5" 1.44MB	3.5" 1.44MB	3.5" 1.44MB	3.5" 1.44MB
Ports	2 Serial, 2 USB, 1 Parallel	2 Serial, 2 USB, 1 Parallel	2 Serial, 2 USB, 1 Parallel	2 Serial, 2 USB, 1 Parallel	2 Serial, 2 USB, 1 Parallel
Sound	N/A	N/A	N/A	Enhanced Business Pro Audio (ISA)	Enhanced Business Pro Audio (ISA)
CD-ROM	Optional	Optional	Optional	24X[1] Max	24X[1] Max
Intelligent Manageability	Standard	Standard	Standard	Standard	Standard
Keyboard and Mouse	Standard	Standard	Standard	Standard	Standard
Preinstalled Operating System	Windows 95	Windows 95	Windows 95	Windows 95	Windows 95
Limited Warranty[3]	3-Year	3-Year	3-Year	3-Year	3-Year
New Low Prices[4]:	$1,199	$1,289	$1,389	$1,599	$1,729
Lease Price[5]:	$40/mo.	$43/mo.	$47/mo.	$54/mo.	$58/mo.

The listed enhancements and upgrades will also work with the Compaq Deskpro EP Series, Small Business Solutions featured on page 7.

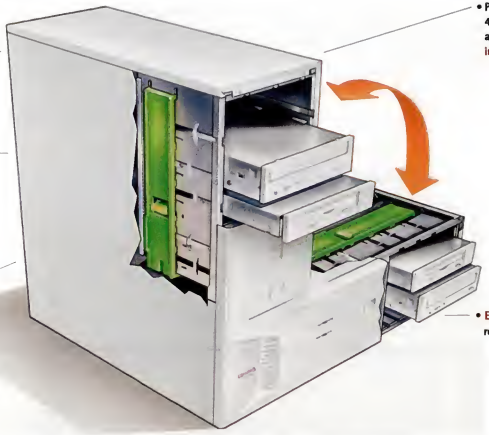
Enhancements & Upgrades*

Additional Memory:	
8MB SDRAM Module	$35
16MB SDRAM Module	$55
32MB SDRAM Module	$99
64MB SDRAM Module	$175
128MB SDRAM Module	$405
Monitor Upgrades:	
Compaq V90 (special)	$105
Compaq P75	$105
Compaq P110	$1,035
Compaq TFT450	$525
Compaq TFT500	$775
Microsoft® IntelliMouse	$60
Compaq 56K ISA Fax Modem	$125
SpeedPaq® ISDN Adapter	$199
TR4 4GB IDE Tape Drive	$249
32X[2] Max CD-ROM Drive	$139
SuperDisk® LS-120 Drive	$129
Network Interface Cards:	
10/100 TX PCI Intel UTP	$75
10/100 TX PCI UTP	$85
10 T PCI UTP	$65
10 T/2 PCI UTP/Coax	$79

With its towerable CPU, the new Deskpro EP fits your changing work environment.

The Compaq Deskpro EP Series is the right choice when you want a desktop that adapts to the changing needs of your business. Its easy-to-use, towerable CPU design lets you easily transform your desktop to a minitower. So whether your space is limited or your business is evolving, it's flexible enough to adapt to your changing work environment.

- Adapts to evolving needs of growing businesses or enterprise environments
- Versatile design features a towerable CPU that's easy to transform from a desktop to a minitower
- Combination of power and flexibility provides relevant, forward-compatible solutions for the long term



- Processor speeds up to 400MHz and bus speeds at 66MHz and 100MHz for industry-leading performance
- External drives rotate 90 degrees

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Deskpro EP Series 100MHz Bus

	6350X/CDS	6400X/CDS
Bus	100MHz	100MHz
Processor	Pentium II 350MHz	Pentium II 400MHz
Std./Max. Memory	64MB/384MB SDRAM	64MB/384MB SDRAM
SMART II Hard Drive	6.4GB Ultra ATA	6.4GB Ultra ATA
Secondary Cache	512KB	512KB
Video Graphics	ATI RAGE PRO TURBO AGP	ATI RAGE PRO TURBO AGP
Video Memory/Max.	4MB SGRAM/4MB	4MB SGRAM/4MB
Total Slots/Bays	6/5	6/5
Compaq Color Monitor	V75 16" viewable	V75 16" viewable
Diskette Drive	3.5" 1.44MB	3.5" 1.44MB
Ports	2 Serial, 2 USB, 1 Parallel	2 Serial, 2 USB, 1 Parallel
Sound	Enhanced Business Pro Audio (ISA)	Enhanced Business Pro Audio (ISA)
CD-ROM	24X[1] Max	24X[1] Max
Intelligent Manageability	Standard	Standard
Keyboard and Mouse	Standard	Standard
Preinstalled Operating System	Windows 95	Windows 95
Limited Warranty[3]	3-Year	3-Year
New Low Prices[4]:	**$2,059**	**$2,189**
Lease Price[4]:	**$69/mo.**	**$73/mo.**

The listed enhancements and upgrades will also work with the Compaq Deskpro EP Series, Small Business Solutions featured on page 3 of this advertisement.

Enhancements & Upgrades[4]

Additional Memory:	
16MB SDRAM Module	$65
32MB SDRAM Module	$89
64MB SDRAM Module	$179
128MB SDRAM Module	$415
Monitor Upgrades:	
Compaq V90 (special)	$105
Compaq P75	$105
Compaq P110	$1,035
Compaq TFT450	$525
Compaq TFT500	$775
Microsoft IntelliMouse	$60
Compaq 56K[2] ISA Fax Modem	$125
SpeedPaq ISDN Adapter	$199
TR4 4GB IDE Tape Drive	$249
SuperDisk LS-120 Drive	$129
Network Interface Cards:	
10/100 TX PCI Intel UTP	$75
10/100 TX PCI UTP	$85
10 T PCI UTP	$65
10 T/2 PCI UTP/Coax	$79

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Power all your business and network applications with the new Deskpro EN Series.

The Compaq Deskpro EN Series of Personal Computers offers all the manageability, serviceability, and consistency your enterprise requires. This high-quality, standards-based solution is designed to easily integrate with your network. And it has all the performance and expandability you'll need as your business evolves.



- Powerful Pentium II performance up to 400MHz
- 512MB ECC cache and up to 384MB SDRAM memory
- Optional Network Interface Card for long-term flexibility and growth
- Up to 8MB of SGRAM video memory with industry-leading ATI RAGE PRO TURBO AGP Graphics Controller
- Available in desktop or minitower form factor
- Error Checking and Correcting memory and Ultra ATA or Wide UltraSCSI SMART II Hard Drives maximize your uptime (see page 19 for ECC memory options)

Deskpro EN Series — Desktops*

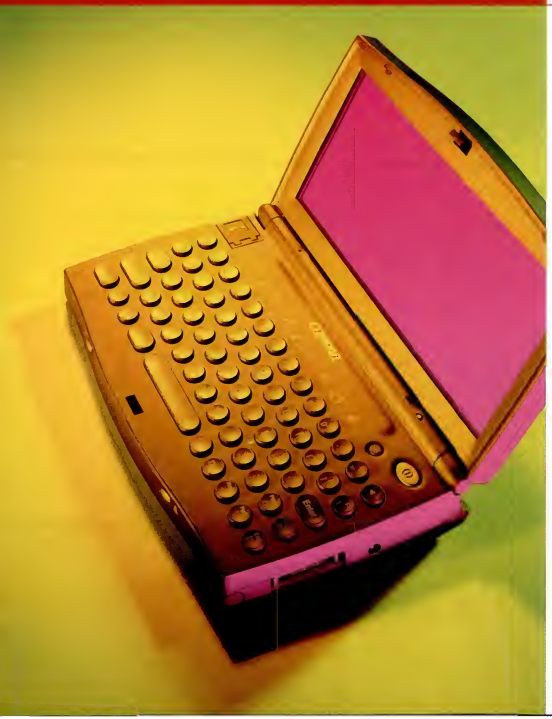
	6266X	6300X	6333X	6350X
Pentium II Processor	266MHz	300MHz	333MHz	350MHz
Bus	66MHz	66MHz	66MHz	100MHz
Std./Max. Memory	32MB/384MB	32MB/384MB	32MB/384MB	32MB/384MB
SMART II Hard Drive	3.2GB Ultra ATA	3.2GB Ultra ATA	3.2GB Ultra ATA	6.4GB Ultra ATA
Secondary Cache	512KB ECC	512KB ECC	512KB ECC	512KB ECC
Video Graphics	ATI RAGE PRO TURBO AGP	ATI RAGE PRO TURBO AGP	ATI RAGE PRO TURBO AGP	ATI RAGE PRO TURBO AGP 2X
Video Memory/Max.	4MB SGRAM/4MB	4MB SGRAM/4MB	4MB SGRAM/4MB	4MB SGRAM/8MB
Total Slots/Bays	5/4	5/4	5/4	5/4
Compaq Color Monitor	V75 16" viewable	V75 16" viewable	V75 16" viewable	V75 16" viewable
Diskette Drive	3.5" 1.44MB	3.5" 1.44MB	3.5" 1.44MB	3.5" 1.44MB
Ports	2 Serial,2 USB, 1 Parallel	2 Serial,2 USB, 1 Parallel	2 Serial,2 USB, 1 Parallel	2 Serial,2 USB, 1 Parallel
Network Interface Card	Optional	Optional	Optional	Optional
Audio	Premier Sound ESS 1869 16-bit Full Duplex (embedded)	Premier Sound ESS 1869 16-bit Full Duplex (embedded)	Premier Sound ESS 1869 16-bit Full Duplex (embedded)	Premier Sound ESS 1869 16-bit Full Duplex (embedded)
CD-ROM	Optional	Optional	Optional	Optional
Intelligent Manageability	Standard	Standard	Standard	Standard
Keyboard and Mouse	Standard	Standard	Standard	Standard
Preinstalled Operating System	Windows 95	Windows 95	Windows 95	Windows 95
Limited Warranty[3]	3-Year	3-Year	3-Year	3-Year
New Low Prices[4]:	**$1,629**	**$1,709**	**$1,829**	**$1,197**
Lease Price[5]:	**$55/mo.**	**$57/mo.**	**$61/mo.**	**$66/mo.**

*Call for availability of minitower form factors.

Enhancements & Upgrades*

Additional Memory:	
8MB SDRAM Module	$35
16MB SDRAM Module	$65
32MB SDRAM Module	$99
64MB SDRAM Module	$179
128MB SDRAM Module	$415
Video:	
4MB WRAM	$95
Matrox Millennium II	$205
Monitor Upgrades:	
Compaq V90 (special)	$105
Compaq P75	$105
Compaq P110	$1,035
Compaq TFT450	$525
Compaq TFT500	$775
Microsoft IntelliMouse	$60
Compaq 56K[2] ISA Fax Modem	$125
SpeedPaq ISDN Adapter	$199
TR4 4GB IDE Tape Drive	$249
32X[7] Max CD-ROM Drive	$139
SuperDisk LS-120 Drive	$129
UltraSCSI controllers	
Network Interface Cards:	
10/100 TX PCI Intel UTP	$75
10/100 TX PCI UTP	$85
10 T PCI UTP	$65
10 T/2 PCI UTP/Coax	$79

To order, visit **www.directplus.compaq.com** Or call **1-800-888-5858**



You've got the whole world in your hand

with the Compaq C-Series Handheld PC.

When you're away from your desktop, what can you do when you need access to critical business information? You can carry the first professional Handheld PC – the Compaq C-Series. It's the fastest, easiest, and most secure way to access your desktop or portable when you're out of the office. Access files, e-mail, or faxes, or browse the Internet on the go. And because desktop synchronization is easy, you'll never have to input data twice.

Compaq C-Series Handheld PC:

- Lets you view documents, spreadsheets, and presentations from anywhere in the world
- Exceptional security features help protect your data
- Lightweight, easy to carry – less than 1 pound
- Windows CE 2.0 operating system – Pocket versions of Microsoft Word, Excel, PowerPoint,[2] Internet Explorer, and InBox*
- 1-Year Limited Warranty[3]

Compaq C-Series

	810 (Monochrome)	2010C (Color)
High-Performance RISC-based MIPS Processor	Yes	Yes
Std./Max. Memory	8MB/20MB	20MB/32MB
Display	6.1" x 2.3"	6.1" x 2.3"
Modem	33.6Kbps	33.6Kbps
Power Supply	2 AA Batteries	NiMH Rechargeable Batteries
Expansion	Type II PCMCIA Slot, 16MB EDO Memory	Type II PCMCIA Slot, 16MB EDO Memory
Dimensions/Weight	1.34" x 7.32" x 3.93"/13.9 oz.	1.61" x 7.32" x 3.93"/15.2 oz.
Limited Warranty[3]	1-Year mail in	1-Year mail in
New Low Prices[4]:	**$499**	**$799**
Lease Price[5]:	**$17/mo.**	**$29/mo.**

Cradle

Quick, drop-in-style docking. Connects to both serial and battery charger connections, and includes a convenient stylus holder. **$39[4]**



Memory Expansion

Get even higher performance from your C-Series Handheld PC. This 16MB EDO RAM upgrade* gives you more storage space and increases capacity for running multiple programs. **$85[4]**

Stylus 3-Pack

Misplace your stylus? With this convenient set of extras, you'll always have a spare on hand. **$9[4]**

NiMH Battery Pack

Save money on batteries with a rechargeable NiMH battery. Depending on use, up to 20 hours of power on mono C-Series, up to 3 hours on color model. Includes charger. **$19[4]**

C-Series Cases

Compaq Slip Case **$19[4]**

The model 810 is standard with 4MB EDO RAM and an additional 4MB in the expansion slot. The model 2010C is standard with 16MB EDO RAM and an additional 4MB in the expansion slot. Both the 810 and the 2010C are upgradable by removing the 4MB EDO RAM standard in the expansion slot and adding the 16MB EDO RAM upgrade.



Compaq Carrying Case **$49[4]**

Compaq Portfolio Case **$99[4]**

10MB Flash RAM PC Card

Enables you to increase storage or create secure backups of data. It provides you with 10MB of ATA-compatible Flash RAM storage. **$125[4]**

Auto Adapter

Get things done while you're sitting in traffic, and save your batteries for when you need them. Plugs into cigarette lighter. **$29[4]**

AC Adapter

Plug into an AC outlet and you're set to go — without using battery power. Separate models for U.S., U.K., Europe, and Australia. Each is worldwide voltage compatible. **$29[4]**

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Great value is one more reason to choose these powerful all-in-one portables.

Choose the Compaq Armada 1500 or 1700 if you want ultimate convenience without sacrificing performance. They offer industry-leading technologies – such as fast processors and 4GB SMART Hard Drives. For maximum convenience on the road, they have an integrated AC adapter, CD-ROM, floppy drive, and K56flex[2] modem built in.

- Up to 266MHz Mobile Pentium II or Pentium Processors with MMX Technology
- Integrated AC adapter, 20X[1] or 24X[1] Max CD-ROM drive, and 56K[2] modem for hassle-free mobile computing (Armada 1700 also supports optional DVD)
- Armada 1700 MultiBay* support for diskette drive, SuperDisk LS-120, second hard drive, second battery, and optional Zip drive



- Up to 96MB* of memory for demanding applications
- 12.1" or 13.3" CTFT display and fast-response dual scan technology for vivid colors and greater viewing angles
- Support for NiMH and Li-Ion batteries, with up to 6 hours of battery life[3]

Armada 1598 shown above
(See page 28 for photo of 1700)

*When upgrade becomes available, memory will be expandable to 160MB.

Compaq Armada 1500 and 1700 Series

	Armada 1505DM	Armada 1573DM	Armada 1592DMT	Armada 1598DMT	New Armada 1700	New Armada 1700
Pentium Processor	200MHz w/MMX	233MHz w/MMX	233MHz w/MMX	266MHz w/MMX	233MHz Mobile Pentium II	266MHz Mobile Pentium II
Std./Max. Memory	32MB/96MB	32MB/96MB	32MB/96MB	32MB/96MB	32MB/96MB	32MB/96MB
SMART Hard Drive	2.1GB	3.2GB	3.2GB	4GB	4GB	4GB
L2 Cache	512KB	512KB	512KB	512KB	512KB	512KB
Communications	K56flex[2]	K56flex[2]	K56flex[2]	K56flex[2]	K56flex[2]	K56flex[2]
DualBay Diskette Drive	3.5" 1.44MB	3.5" 1.44MB	3.5" 1.44MB	3.5" 1.44MB	3.5" 1.44MB	3.5" 1.44MB
CD-ROM	20X[6] Max	20X[6] Max	20X[6] Max	20X[6] Max	24X[1] Max	24X[1] Max
Display	12.1" CSTN SVGA	12.1" CSTN SVGA	12.1" CTFT	13.3" CTFT (1024x768)	12.1" CTFT	13.3" CTFT (1024x768)
Video Support (All Models)	64-bit Local Bus Graphics with 2MB EDO Video RAM					
PC Card Slots	2 Type II or 1 Type III	2 Type II or 1 Type III	2 Type II or 1 Type III	2 Type II or 1 Type III	2 Type II or 1 Type III	2 Type II or 1 Type III
Compaq Premier Sound	Standard	Standard	Standard	Standard	Standard	Standard
IR	4Mbps Compliant	4Mbps Compliant	4Mbps Compliant	4Mbps Compliant	4Mbps Compliant	4Mbps Compliant
Battery Type/Life	NiMH	Dual Li-Ion Battery Support, up to 2-3 Hours per Battery[8]				
Pointing Device	Touchpad	Touchpad	Touchpad	Touchpad	Touchpad	Touchpad
Ports (All Models)	Serial, Enhanced Parallel, Keyboard/Pointing Device, Ext. Monitor, Fast IR, Audio In, Headphone Out, Mic, AC and Convenience Base RJ-11, USB					
Intelligent Manageability	Standard	Standard	Standard	Standard	Standard	Standard
Preinstalled Operating System*	Windows 95	Windows 95	Windows 95	Windows 95	Windows 95	Windows 95
Dimensions/Weight (lbs.)	2.1" x 12.2" x 9.6"/7.61	2.1" x 12.2" x 9.6"/7.61	2.1" x 12.2" x 9.6"/7.49	2.1" x 12.2"x 9.6"/7.97	2.3" x 12.5" x 9.9"/7.9-8	2.3" x 12.5" x 9.9"/7.9-8
Worldwide Limited Warranty[3]	1-Year, upgradable	1-Year, upgradable	1-Year, upgradable	1-Year, upgradable	1-Year, upgradable	1-Year, upgradable
New Low Prices[4]:	**$1,599**	**$1,919**	**$1,999**	**$2,499**	**$2,499**	**$2,999**
Lease Price[5]:	**$54/mo.**	**$64/mo.**	**$67/mo.**	**$84/mo.**	**$84/mo.**	**$101/mo.**

*Other operating systems available

Enhancements & Upgrades[4]

Additional Memory:	1500 (EDO)	1700 (SDRAM)
16MB Module	$49	$55
32MB Module	$105	$95
64MB Module	$205	$185

Convenience Accessories:	
Ethernet Base (1500 only)	$279
Pass-Through Base (1500 only)	$189
Ethernet Base (1700 only)	$279
Pass-Through Base (1700 only)	$189
DVD Drive (1700 only)	$489
Compaq Mouse	$35
Microsoft IntelliMouse	$60
Compaq Keyboard	$85
Portable Videoconferencing Kit	$390
Compaq Security Lock	$55
Compaq Cases (see page 40)	

Monitors (see page 22):	
Compaq V75	$425
Compaq V90 (special)	$530
Compaq TFT450	$949

Power Accessories:	
NiMH Battery (1500 only)	$95
Li-Ion Battery	$189
Battery Charger	$95
Auto/Aircraft Adapter	$99

PC Cards:	
10/100 TX PC Card UTP	$145
10T PC Card UTP	$119
10/2 PC Card Coax	$135
10/100 TX PC Card UTP Upgrade	$99
16/4 PC Card IBM UTP/STP	$275
56K[2] PC Card Modem	$179
Compaq Microcom TravelCard Fast 33.6 PC Card Modem	$179

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Industry leading, high-end portables with desktop-level power and expandability.

The Armada 7000 Series combines industry-leading performance and mobility with unprecedented desktop-level expandability. So you get the cutting-edge speed and portability you need for your multimedia and communications applications on the road. And in the office, you get the fastest available networking for your database, workgroup, or file/print needs.

- **Armada 7300: A compact, lightweight notebook with the perfect combination of power, portability, and expansion**



- **Armada 7800: The first Mobile Pentium II notebook from Compaq — it delivers the fastest processing performance and AGP graphics**





- **Armada 7700: Cutting-edge performance and an innovative, expandable design — for full desktop equivalency**

Armada 7000 Series

	Armada 7362DMT	Armada 7380DMT	Armada 7770DMT	Armada 7792DMT	Armada 7800	Armada 7800
Pentium Processor	233MHz w/MMX	266MHz w/MMX	233MHz w/MMX	266MHz w/MMX	266MHz PII	266MHz PII
Std./Max. Memory	32MB/128MB	32MB/128MB	32MB/144MB	32MB/144MB	64MB/256MB	64MB/256MB
SMART Hard Drive	3GB	4GB	3GB	5GB	5GB	8GB
L2 Cache	512KB	512KB	512KB	512KB	512KB	512KB
Integrated Communications	33.6Kbps, upgradable to 56K[2] Flex protocol	33.6Kbps, upgradable to 56K[2] Flex protocol	33.6Kbps, upgradable to 56K[2] Flex protocol	33.6Kbps, upgradable to 56K[2] Flex protocol	33.6Kbps, upgradable to 56K[2] Flex protocol	33.6Kbps, upgradable to 56K[2] Flex protocol
DualBay Diskette Drive	Removable 3-mode 1.44MB	Removable 3-mode 1.44MB	Removable 3-mode 1.44MB	Removable 3-mode 1.44MB	Removable 3-mode 1.44MB	Removable 3-mode 1.44MB
CD-ROM	MultiBay 20X[6] Max	MultiBay 20X[6] Max	MultiBay 20X[6] Max	MultiBay 20X[6] Max	MultiBay 20X[6] Max	MultiBay 20X[6] Max
Display	12.1" CTFT SVGA	12.1" CTFT (1024 x 768)	12.1" CTFT (800 x 600)	13.3" CTFT (1024 x 768)	13.3" CTFT (1024 x 768)	14.1" CTFT (1024 x 768)
Video Support	Yes	Yes	Yes	Yes	Yes	Yes
PC Card Slots	2 Type II or 1 Type III	2 Type II or 1 Type III	2 Type II or 1 Type III	2 Type II or 1 Type III	2 Type II or 1 Type III	2 Type II or 1 Type III
Compaq Premier Sound	Standard	Standard	Standard	Standard	Standard	Standard
Battery Type/Life[8]	Li-Ion, up to 3 Hours	Li-Ion, up to 3 Hours	Li-Ion, up to 3 Hours	Li-Ion, up to 3 Hours	Li-Ion, over 2 Hours	Li-Ion, over 2 Hours
Pointing Device	EasyPoint™ III	EasyPoint III	EasyPoint III	EasyPoint III	EasyPoint III	EasyPoint III
Ports (All Models)	Serial, Enhanced Parallel, Keyboard/Pointing Device, External Monitor, IR, Audio In, Headphone Out, Mic, AC, Convenience Base RJ-11 (Armada 7800 models also include USB)					
Intelligent Manageability	Standard	Standard	Standard	Standard	Standard	Standard
Preinstalled Operating System**	Windows 95	Windows 95 or Windows NT 4.0**	Windows 95	Windows 95 or Windows NT 4.0**	Windows 95	Windows 95 or Windows NT 4.0**
Dimension/Weight (lbs.)	1.5" x 12" x 9.27" 6 lbs.	1.5" x 12" x 9.27" 6 lbs.	2" x 12.6" x 9.5" 7.9 lbs.	2" x 12.6" x 9.7" 8 lbs.	2" x 12.6" x 10.2" 7.8-9 lbs.	2" x 12.6" x 10.2" 8.0-9.2 lbs.
Worldwide Limited Warranty[3]	3-Year	3-Year	3-Year	3-Year	3-Year	3-Year
New Low Prices[4]:	**$2,699**	**$3,299****	**$2,699**	**$3,499****	**$4,399**	**$5,199****
Lease Price[5]:	**$91/mo.**	**$111/mo.**	**$91/mo.**	**$117/mo.**	**$148/mo.**	**$170/mo.**

*Other operating systems available.
**Ask your operator for Windows NT 4.0 prices.
†For use with ArmadaStations only.

Enhancements & Upgrades[4]

Additional Memory:	
16MB Module	$55
32MB Module	$105
64MB Module	$205

Convenience Accessories:	
ArmadaStation	$779
ArmadaStation II	$879
ArmadaMiniStation†	$439
ArmadaStation Tower Stand	$99
Compaq Mouse	$35
Compaq Keyboard	$85
Microsoft IntelliMouse	$60
MultiBay SuperDisk LS-120	$219
TR4 4GB IDE Tape Drive†	$249
Portable Videoconferencing Kit	$390
Compaq Security Lock	$55
Compaq Cases	

Monitor Upgrades (see page 22):	
Compaq V75	$425
Compaq V90 (special)	$530

Power Accessories:	
Li-Ion Battery	$199
Battery Charger	$129
Auto/Aircraft Adapter	$99

PC Cards:	
10/100 TX PC Card UTP	$145
10T PC Card UTP Controller	$119
10/2 PC Card Coax Controller	$135
10/100 TX PC Card UTP Upgrade	$99
16/4 PC Card IBM UTP/STP	$275
56K[2] PC Card Modem	$179
Compaq Microcom TravelCard Fast 33.6 PC Card Modem	$179

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Easy-to-manage, affordable servers that grow with your business.

If you thought a file and print server was cost-prohibitive, here's a remarkably affordable solution — the Compaq ProSignia 200. Ideal for any kind of growing business, the ProSignia 200 brings you powerful server features for the cost of a desktop PC. For starters, you'll get a lightning-fast Intel Pentium II processor. And 32MB memory, expandable to 384MB. Plus five storage bays that support three hard drives. It's next-generation technology that's designed to grow with your business.

ProSignia 200 servers deliver:

- 300MHz Pentium II Processor and up to 384MB ECC memory
- Compaq SmartStart for easier setup of your ProSignia 200
- Compaq Insight Manager alerts you to potential hardware problems
- Automatic Server Recovery for reboot, critical reports, and calls for help
- Built with Enterprise-class components
- 3-Year Warranty[3]

Compaq ProSignia 200

	ProSignia 200 6/300
Pentium II Processor	300MHz
Std./Max. Memory	32MB of 32-bit FPM ECC SIMM/384MB
L2 Cache	512KB
Expansion Slots	5 total: 3 PCI, 1 ISA, 1 shared
Network Controller	10/100 T/2 PCI UTP/Coax Controller (embedded)
Storage Controller	Integrated Enhanced IDE or Wide-Ultra SCSI-3 Controller
Storage and Expansion Bays	5 total: 1.44MB diskette drive, 1 internal 16X Max CD-ROM IDE, one 4.3GB hard drive, and 2 available 5.25" removable media bays
Maximum Storage	22GB SCSI
External	509.6GB
Interfaces	2 Serial, 1 Parallel, Mouse, Keyboard, RJ-45, BNC
Graphics	1024 x 768, 256 colors in PCI slot upgradable to 2MB
Wide UltraSCSI Hard Drive	4.3GB
Manageability	Compaq Insight Manager, Automatic Server Recovery-2 (ASR-2), Pre-Failure Warranty
Security	Power-on password, keyboard password, diskette drive control, diskette boot control, network server mode, security provision; parallel and serial interface control, administrator password, disk configuration lock
Server Management	SmartStart, Compaq Insight Manager
Power Supply	280 Watts, Power Factor, Corrected, CE Mark Compliant
Limited Warranty[3]	3-Year On-Site
New Low Price[4]:	**$2,220**
Lease Price[5]:	**$75/mo.**

**Only available at time of Compaq Server purchase.*
†Databases and Web server software required.



Enhancements & Upgrades[4]

Additional Memory:	
32MB ECC SIMM Upgrade 6/300	$139
64MB ECC SIMM Upgrade 6/300	$269
128MB ECC SIMM Upgrade	$639
Additional Hard Drives:	
4.3GB Wide UltraSCSI (1" high)	$567
9.1GB Wide UltraSCSI (1.6" high)	$1,067
Tape Drives:	
4/8GB SLR Tape Drive (internal)	$505
12/24GB DDS-3 DAT Drive (internal)	$1,193
UPS Model 700	$400
K56flex[2] ISA Fax Modem	$125
Software:	
IntraNetics97®*†	$1,595

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Compaq Armada 1505DM
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All-in-one business notebook with great value – provides industry-leading speeds and superior mobility for a smart solution.

- 200MHz Intel Pentium Processor with MMX Technology
- Up to 96MB of memory
- 12.1" CSTN display and dua-scan technology for sharp, vivid colors
- Supports NiMH battery, with 2-3 hours[8] of battery life
- Integrated AC adapter, 20X[5] Max CD-ROM, and K56flex[2] modem

Compaq Deskpro EP Series 6266X/2100
$1,199* or lease for $40/mo.‡

An integrated hardware/software solution for growing businesses that demand cutting-edge technology and long-term flexibility.

- 266MHz Intel Celeron Processor and 66MHz Front Side Bus
- Easily converts from desktop to minitower
- 32MB SDRAM and 2.1GB SMART II Ultra ATA Hard Drive
- ATI RAGE IIC AGP graphics, 2MB EDO RAM
- Preinstalled Microsoft Word 97, Internet Explorer 4.0, Norton AntiVirus 4.0, and INEX Commerce Court Publisher*

*Retail software packages not included. Software shown is prebundled and will come with limited user documentation.

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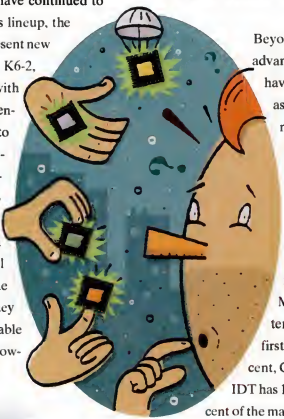
*24X Max CD-ROM: Data transfer rates vary from 150KB/s to 3600KB/s. **K56flex protocol:** Designed to allow faster downloads from K56flex-compliant sources. Maximum achievable download transmission rates currently do not reach 56Kbps and will vary with line conditions. Upgradable to ITU 56K Standard. **Limited Warranty:** Compaq offers one of the most extensive warranties offered on a PC by any company. Ask for a copy of the limited warranty for any product featured in this catalog or call for details. Certain restrictions and exclusions apply. All warranty periods represent time from initial purchase. Battery packs and certain options are covered by a One-Year Limited Warranty.‡ Standard coverage includes: Compaq Desktop Products Designo FN and EP – three years parts, first year on-site labor. Warranty service for parts in years two and three is provided via Carry-In Service. For Carry-In Service, you may bring the PC into any Compaq-authorized service provider. Compaq Portable Products Armada 4200, Armada 7300, and Armada 7700 – three years parts and labor with Pick-Up/Carry-In Service. For Pick-Up Service, call the Compaq Technical Support Center. If your portable computer needs hardware repair under warranty, Compaq will supply packaging, pick up the PC at your location, repair it, and return it to you. Compaq pays for all postage. U.S. only. Armada 1500 – one year parts and labor coverage with Pick-Up/Carry-In Service. Compaq Monitors P75, P110, V75, V90, 7T4561, 7T7500 – three years parts, with first year on-site labor. V56 – one year on-site warranty, which covers parts and labor. Compaq ProSignia 200 Server – Only Compaq SCSI hard drives that are connected to one of the Compaq array controllers and monitored by Compaq Insight Manager are covered by the prolifiqua warranty. The IDE hard drives supported on the ProSignia 200 are not supported by the prolifiqua warranty since they cannot be monitored by a Compaq SCSI array controller. Compaq C-Series Handheld PC – Certain restrictions and exclusions apply. Battery packs and certain options are covered by a one-year limited warranty. Consult the Compaq Product Information Center for details. Compaq 48-Hour Monitor Swap: If your Compaq V5s, V7s, V90, P75, or P110 monitor needs servicing at any time within the warranty period, you can get a replacement monitor directly from Compaq within 48 hours from the time you place your service call. **All prices** shown are DirectPlus prices and are subject to change. Prices do not include applicable state and local sales tax or shipping to recipient's destination. **‡Leasing:** Leasing available through Compaq Capital Corporation ("CCC") to qualified commercial customers, subject to credit approval and execution of CCC lease documentation. Monthly lease payments are based on 36-month fair market value lease, and do not include taxes, fees, or shipping charges. Offering subject to other restrictions and CCC reserves the right to change, alter, or cancel this offering at any time without notice. **10X Max CD-ROM:** Data transfer rates may vary from 1,274KB/s to 3000KB/s. **12X Max CD-ROM:** Data transfer rates up to 4800KB/s. **Battery Life:** Actual results may vary with individual usage. When tested in standard configuration, using the Ziff-Davis Battery Mark Test version 2.0, the battery life of the Armada 7800 will range up to 2.3 hours. Standard configuration at time of announcement (4Q/98) is considered to be one battery, a 1024 x 768 (256 colors) panel set at 50% brightness, 64MB RAM, and no drives other than the hard drive active.

The Right CPU for You

By Michael Slater

PC Magazine Labs puts today's top processors through benchmark and application testing to help you select the best one.

Over the past year, the CPU choices facing buyers of desktop PCs have continued to widen. Within Intel's lineup, the Celeron and Xeon chips present new options. AMD added the K6-2, the first processor with 3DNow! instruction-set extensions; Cyrix added MMX to the MediaGX; and newcomer IDT not only began shipping the WinChip but also added the second-generation WinChip 2. Although the Intel alternatives still don't reach all the way to the top of Intel's product line, they are maintaining a respectable position in midrange and low-end systems.



Beyond just their technical advances, the Intel alternatives have also increased in relevance as the number of top-tier PC makers using them has risen: Systems with AMD or Cyrix processors are now offered by Acer, Compaq, CTX, Hewlett-Packard, IBM, and Packard Bell—the top-selling six brands in the U.S. retail channel. According to MicroDesign Resources, in terms of chip shipments in the first half of 1998, AMD has 9 percent, Cyrix/IBM has 6 percent, and IDT has 1 percent; Intel retains 84 percent of the market share.

Understanding the relative performance positions of the various processors is difficult when you look just at benchmark results from commercial systems, since many other factors—such as memory size and type, graphics accelerators, and disk drives—often have a significant impact on overall performance. To help you decide which is the best microprocessor for your needs, *PC Magazine* presents

Join us online

Please join us online for an interactive look at the right CPU for you.

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ILLUSTRATIONS BY JACK GALLAGHER

benchmark test results not from off-the-shelf systems (unlike in our usual roundups) but from systems that we have carefully assembled to minimize changes to all variables other than the microprocessor itself.

We tested the Intel Celeron and Pentium II, the AMD K6-2, and the Cyrix MII, all at 300 MHz (or, in Cyrix's case, rated for 300-MHz equivalent performance) to see how all the chips compare at the same speed. We also tested the 350- and 400-MHz Pentium IIs to see how much benefit they offer, and we tested the 233-MHz Pentium MMX to establish a baseline. (Unfortunately, we were unable to obtain a WinChip 2 system in time to include it in this roundup.)



COMPARING THE CPUs

Because different applications stress different aspects of a processor's design, the relative performance of any two processors varies considerably from one task to another. Thus, no single rating can give a good view of the performance of a processor. To understand the strengths and weaknesses of each processor, you need to look at its performance on a range of benchmark tests.

If traditional PC applications (such as word processing, spreadsheets, databases, and Web browsing) are what matter to you, focus on ZD Business Winstone 98 test results. This test program measures system performance while running mainstream productivity applications. These applications use mostly integer functions; for a look at pure CPU integer performance, see our CPUmark$_{32}$ test results.

Our performance tests show that Intel's Celeron/300 and Pentium MMX/233 deliver only about three-fourths the performance of a Pentium II/300, making them the worst choices if mainstream applications are your priority. AMD's K6-2/300 is very close to the Pentium II/300 in Winstone performance at 300 MHz, and Cyrix's MII/300 falls about 10 percent short. The fastest chip, the Pentium II/400, is only about 10 percent faster than the 300-MHz units; so based on chip prices alone, the Pentium II/400 is too expensive for the value it offers this class of applications. At current prices, this translates to a $350 price difference for comparably equipped systems.

If having the best 3-D game performance is what counts, however, the picture is quite different. Intel's Pentium II shines, but thanks to the new instruction set called 3DNow!, it has some competition. 3DNow! is a floating-point version of the MMX instructions created by AMD, Cyrix, and IDT to boost their processors' performance on transform and lighting tasks. Currently, the major application of 3DNow! is in 3-D games; only a handful of 3DNow!-optimized games are currently available, with about a dozen more due this fall.

Our preliminary findings with beta DirectX 6.0 code and beta graphics board drivers enabled for 3DNow! indicate that the K6-2 has caught up with the Pentium II (at the same clock speeds); far greater gains are possible, once every part of the puzzle is fully optimized. But AMD's K6-2, when used with software that does not make use of 3DNow! instructions, lags considerably behind the Pentium II. The Cyrix MII falls below even the Pentium MMX because of its relatively poor floating-point performance.

On multimedia tasks such as video decoding and still-image processing, AMD's K6-2 matches the Pentium II's performance at the same clock speed in many cases, but Cyrix's MII falls short. This too is encouraging for AMD, because earlier K6 processors were much slower on MMX processing than Pentium and Pentium II chips. The 400-MHz Pentium II shows a big gain over the 300-MHz version on many multimedia tasks, because these applications often don't fit well in the L2 cache, making the faster processor's 100-MHz memory interface valuable.

If low cost is your main concern, you can get a very usable computer at a remarkably low price by choosing one with an IDT WinChip, a Cyrix MediaGX or 6x86MX, or AMD's original K6. As for the Celeron, the current version has little to recommend it, but a version with 128K



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	Brightness	Resolutions Supported	Applications
MultiSync LT Series	600-900 lumens	640 x 480-1280 x 1024 with AccuBlend	Ultraportable design. Road warriors, your projector is ready.
MultiSync MT Series	800-1300 lumens	640 x 480-1280 x 1024 with AccuBlend	Perfect for conference/board room; smart choice for training and classrooms.
MultiSync GT Series	600 lumens	640 x 480-1600 x 1200 with AccuBlend	Makes high-end CAD/CAM presentations come to life.

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The Future of Microprocessors

	3Q '98	4Q '98	1Q '99	2Q '99	3Q '99
INTEL	**Mendocino** A Celeron with 128K of on-chip L2 cache.		**Katmai** Adds a set of new extensions called KNI (Katmai New Instructions).		**Merced** Shipping date planned for the second half of 1999 has been postponed until mid-2000.
AMD	**K6-2** Features a faster MMX unit and 3DNow!	**K6-3** Features 256K of on-chip L2 cache.		**K7** AMD's next-generation CPU; uses a Slot A bus	
CYRIX	**MII** Essentially a renamed 6x86MX that runs at higher core and bus speeds.		**MXi** Features a much faster CPU core and 3-D graphics unit.		
IDT	**WinChip 2** Features faster FP and MMX units as well as 3DNow!	**WinChip 2+** Features 128K of on-chip L1 cache, twice as much as the WinChip 2.		**WinChip 3** Super-pipelined for high clock speed.	**WinChip 2+NB** Eliminates the CPU bus, allowing for high-speed access to memory

of integrated L2 cache (code-named Mendocino) will be available in mid-August.

UNDERSTANDING INTEL'S LINEUP

With the Celeron's debut, Intel has entirely dropped the Pentium MMX processor from its desktop offerings. The initial Celeron processor, available in 266- and 300-MHz versions, is nothing more than a Pentium II without an L2 cache. The Celeron uses the same Slot 1 connector as the Pentium II, but there are no chips on the module other than the processor itself. Because it lacks an L2 cache, the Celeron processor is significantly slower than a Pentium II processor at the same speed. Unless you need to cut costs to the bone, you're far better off with a Pentium II/266 than with a Celeron/300.

The Celeron line is about to become much more interesting as Intel rolls out the new Mendocino in mid-August, which has 128K of L2 cache right on the processor chip. Although this cache is only one-fourth the size of the 512K cache in a Pentium II, it is twice as fast. On many applications, the Mendocino will come close to the performance of a Pentium II at the same clock speed.

The Mendocino-based Celerons will initially be offered at 300 and 333 MHz. To distinguish between 300-MHz Celerons with and without integrated L2 cache, the Mendocino version will be called the Celeron/300a. The original Celerons will quickly disappear from the market.

The Pentium II line takes up where Celeron leaves off. In the long run, Intel probably will eliminate any clock-speed overlap; the slowest Pentium II will be one speed grade above the fastest Celeron, simplifying the positioning. This fall, however, there will be overlap. The 233- and 266-MHz Pentium II chips are likely to disappear quickly, but the 300- and 333-MHz versions will persist through the end of the year. Deciding between these and a Celeron system (with integrated L2) of the same speed may be difficult; the Pentium II will deliver better performance but not necessarily much better. In many cases, though, PC makers will bundle faster graphics cards, larger hard disks, and more memory with the Pentium II systems, helping to differentiate them.

If performance is more important than low cost, head straight for the 400-MHz Pentium II (or soon, the 450-MHz version). In addition to their higher clock speeds, the processors (along with the 350-MHz version) are the first in Intel's line to use a 100-MHz system bus. The faster bus does not make a dramatic difference in many applications, since the L2 cache in a Pentium II CPU runs at one-half the CPU's speed regardless of the system bus speed. For applications such as video processing, however, which involve long data streams that don't fit in the cache, the 100-MHz bus is a significant benefit.

At the very high end of Intel's line is the Xeon Pentium II, which uses the new Slot 2 interface (an enhanced Slot 1 with a modified cartridge that supports up to four processors). This processor uses the same CPU chip as the newest Pentium IIs, but the L2 cache uses a custom Intel-built chip to transfer data to the CPU at its full clock speed. (There are several cycles of latency, so the L2 cache isn't as fast as the L1 cache; but once a transfer starts, successive data items are transferred at the processor's full speed.) Xeon modules are also available with larger L2 caches—1MB now and 2MB to debut this fall.

The Xeon processors are intended for workstations and servers, however, not for PCs, and are priced accordingly—starting at about $1,100. The processors will be attractive in a multiprocessor server, which may have many thousands of dollars worth of hard disks and DRAM and may sell for tens of thousands of dollars, but for PC buyers, the Xeon is just a distraction. Note that Slot 2 will not replace Slot 1: It is designed solely to support the large caches and four-way multiprocessor configurations of high-end servers and workstations.

The next major product to join the Intel line is the chip code-named Katmai, which will be an extension to the Pentium II family. Katmai will be the first processor to introduce Intel's second-generation of instruction set extensions. For the moment, Intel simply calls these Katmai New Instructions (KNI), though some press reports have called them MMX2. Unlike 3DNow! and MMX, which reuse the standard floating-point registers, KNI is likely

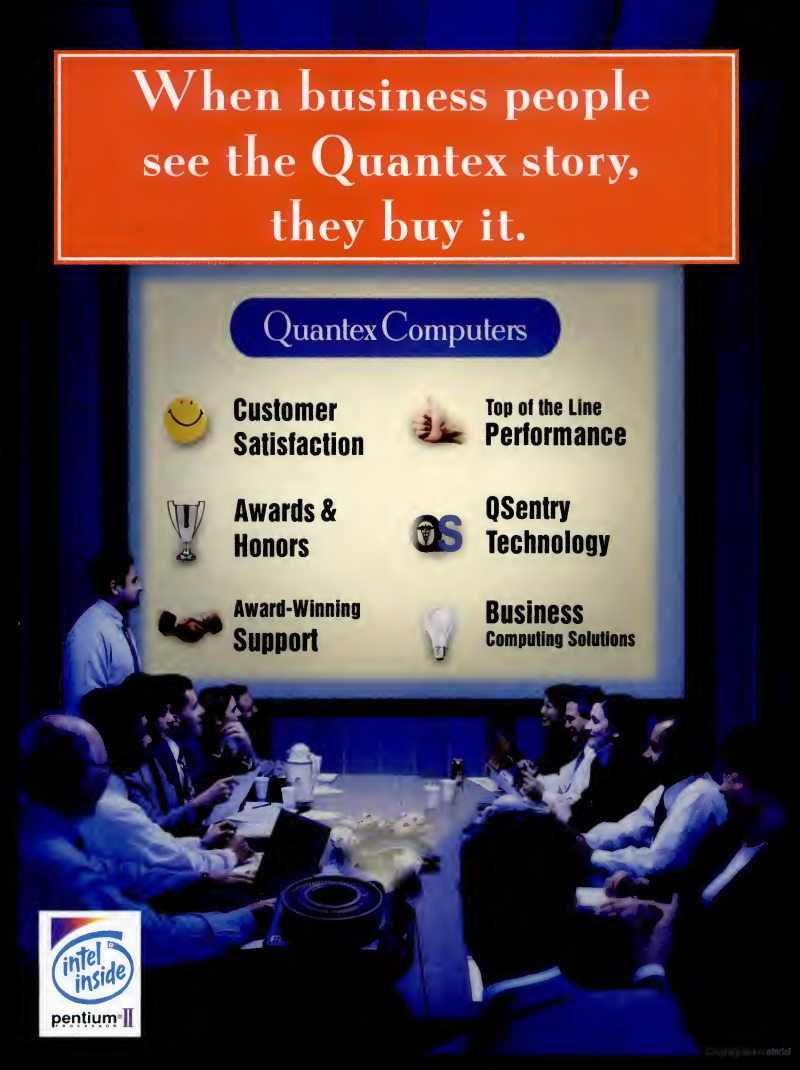
Our Contributors

MICHAEL SLATER is the principal analyst at MicroDesign Resources (*www.mdronline.com*) and executive editor of *Microprocessor Report*. *Microprocessor Report*'s Web site provides an extensive collection of in-depth technical articles on microprocessors for PCs, plus pointers to information at vendors' sites and elsewhere. ROB FRIED was the project leader, and MARY BETH WAS the editor in charge of this story.

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--- **"Service and Reliability Survey," *PC Magazine*, July 1998**
* calculations based on all 25 PC vendors evaluated in the survey.



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to define a new, larger register set and to offer more capability than 3DNow! Intel says that its program to encourage use of KNI is several times the size of the program it ran for MMX. Katmai will debut in early 1999, at clock speeds as high as 500 MHz.

ADVANCING THE K6

AMD has had a slower start than it would have liked with the K6, with difficulties both in getting yield at the top speed grades and in ramping up production using the more advanced 0.25-micron process. The company is currently building both the original K6 and the new K6-2 exclusively in 0.25-micron technology. The K6-2 extends the K6 with 3DNow! instructions, a faster MMX unit, and a 100-MHz bus.



The 3DNow! instructions boost the K6-2's performance on certain 3-D graphics applications that support it. On a fully optimized program, the chip can deliver floating-point performance comparable to the Pentium II. The standard FPU in the K6-2 is unchanged from the earlier version, however, so software that uses standard floating-point instructions instead of 3DNow! will be slower on the K6-2 than on a Pentium II at the same clock speed.

The K6's MMX unit is able to process only one MMX instruction per clock cycle, giving it half the peak performance of Intel's dual-issue design (used in both the Pentium MMX and the Pentium II). In the K6-2, AMD added a second MMX unit, matching the capability of Intel's chips.

The K6-2 is available at speeds of 266, 300, and 333 MHz. AMD wanted to use the faster 100-MHz bus because its chip depends on the bus for connection to the L2 cache. But only the 300-MHz chip actually uses a 100-MHz bus. This is because the bus and CPU speeds are connected by a multiplier that supports half-integer increments. Thus, the 266-MHz version can use a 66- or 88-MHz bus (multiplier of 4 or 3), and the 333-MHz chip has a 95-MHz bus (multiplier of 3.5). These unusual bus speeds require special crystals for the motherboard. AMD promises to ship a 350-MHz version very soon after this article reaches you and a 400-MHz version by the end of the year, both with a 100-MHz system bus.

AMD continues to offer the original K6 at clock speeds of 233, 266, and 300 MHz. This chip does not support a 100-MHz system bus and thus is slower than the K6-2 even on programs that don't benefit from MMX or 3DNow! instructions. For the most cost-sensitive applications, the K6 remains a good processor, but by the end of the year AMD is likely to lower the price of the slowest K6-2, which should essentially make the original K6 obsolete.

Later this year, AMD plans to introduce its third-generation K6 design, the K6-3. This chip will combine the entire K6-2 processor and L1 cache with a 256K L2 cache on the same chip. The on-chip L2 cache will be able to transfer data to the CPU at its full clock speed, rather than being limited by the 100-MHz Socket 7 bus. This will give the K6-3 a big performance boost, even though the CPU core will be unchanged.

CYRIX BOOSTS THE 6x86MX

Cyrix has made only incremental enhancements in its product line. The highly integrated MediaGX, which helped ignite the sub-$1,000 PC market last year, was upgraded in January to a version with MMX. The mainstream 6x86MX got a new name for its fastest version, now called the MII (pronounced *M-two*), but the chip itself gained no new features. It is now built with a more advanced process technology and runs at higher core and bus speeds. (Note that IBM also sells the 6x86MX and MII processors but has stuck with the 6x86MX name for all speeds.)



Because the 6x86MX delivers higher performance per clock cycle, Cyrix continues to use PR performance ratings, which are Intel-equivalent clock speeds, instead of the actual speed. Cyrix included the letters *PR* in the designation of the 6x86MX-PR266, and incorporated the PR rating into the CPU's name with the switch to the MII name: The MII/300 is a 233-MHz chip that Cyrix rates at PR300 (the performance equivalent of a Pentium II/300). Like AMD, Cyrix has reached the 333-MHz level (in integer application performance, not in clock speed), leaving both chip makers two speed grades behind Intel.

There are multiple bus and core speed combinations possible for each Cyrix PR rating. The M11/300 bus/core speeds can be 66/233 or 75/225. The M11-333 can be 66/266, 75/263, or 83/250. (The 333-MHz version was just going into production as we were conducting tests for this article, and we were unable to include it.)

Cyrix is sampling MII CPUs built in a 0.25-micron process. The chips will reduce manufacturing cost and lower power consumption. Cyrix expects to have PR350 and PR400 chips in the fourth quarter.

Cyrix is lagging in implementing 3DNow! instructions and a 100-MHz bus; its floating-point and MMX performance fall behind as well, forcing the company to sell its chips at bargain prices. This makes them good values for typical business applications but weak performers for the most demanding applications.

Cyrix's third-generation enhancement of the 6x86 core, code-named Jalapeño, will first appear in a highly integrated processor code-named the MXi, which is conceptually similar to the MediaGX but has a much faster CPU core and a 3-D graphics unit. Due late this year, the MXi will be the heart of Cyrix's product line in 1999, as it de-emphasizes its Socket 7 processors. Despite rumors that Cyrix will offer a Slot 1 version of the Jalapeño processor, the company has made no formal commitment to do so.

IDT JOINS THE FRAY

One new supplier joined the PC microprocessor market in the past year: Integrated Device Technology (IDT), an established semiconductor company that makes SRAMs, specialty memory, and embedded microprocessors. IDT's first WinChip, originally called the C6, shipped in small quantities in late 1997 and slightly larger quantities in the first



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CPUs

TESTED **NOT TESTED**

■ YES ■ NO	AMD K6-2	Cyrix MII	Intel Celeron	Intel Pentium MMX	Intel Pentium II	Cyrix Media GX	WinChip 2 3D
Introduced	May 28, 1998	April 14, 1998	April 15, 1998	January 8, 1997	May 7, 1997	January 6, 1998	May 19, 1998
Clock speeds (MHz)	266, 300, 333	233 (PR300), 250 (PR333)	266, 300	233; mobile: 200, 233, 266	233, 266, 300, 333, 350, 400; mobile: 233, 266	200, 233	250, 266
Level one (L1) cache	64K	64K	32K	32K	32K	16K	32K
Level two (L2) cache	Controlled by chip set	Controlled by chip set	None	Controlled by chip set	512K on CPU module	None	Controlled by chip set
L2 cache speed	Same as bus	Same as bus	N/A	Same as bus	Half CPU speed	N/A	Same as bus
Type of bus	Super 7 (Socket 7)	Socket 7	Slot 1	Socket 7	Slot 1	None (PCI)	Socket 7
Bus speed (MHz)	88, 95, or 100	66, 75, or 83	66	66	66 or 100	PCI: 33; SDRAM 100	66 or 83
Instructions per clock cycle	2	2	3	2	3	1	1 (2 for MMX)
MMX units	2	1	2	2	2	1	2
3-D extensions	3DNow!	None	None	None	None	None	3DNow!
Pipelined FPU	■ (3DNow! only)	■	■	■	■	■	■
Out-of-order execution	■	■ (limited)	■	■	■	■	■
Process technology (CMOS)	0.25µ	0.25µ	0.25µ	0.35µ and 0.25µ	0.25µ and 0.35µ	0.35µ and 0.3µ	0.35µ and 0.25µ
Die size	81 mm², 118 mm²	88 mm², 119 mm²	131 mm²	128 mm², 95 mm²	203 mm², 131 mm²	142 mm², 112 mm²	95 mm², 58 mm²
Transistors	9.3 million	6.5 million	7.5 million	5.5 million	7.5 million	2.4 million	6 million

N/A—Not applicable: The CPU and its chip set do not support this feature

half of this year, but it represents less than 1 percent of the PC microprocessor market. IDT has not yet targeted larger PC makers because its volume production capability has been limited, but it will have much greater capacity later this year from its own fab and through a foundry agreement with IBM.

IDT recently announced its second-generation design, called the WinChip 2, which includes 3DNow! extensions and a range of smaller enhancements that collectively boost performance about 10 percent, at the same clock speed, over the original WinChip. Like AMD's K6-2, the WinChip 2 adds a dual-issue MMX unit. Unlike AMD, IDT also reworked the floating-point unit to bring it close to Intel's performance. IDT is offering the WinChip 2 with or without the 3DNow! extensions; a "3D" suffix distinguishes the two parts.

Because its process technology has lagged and it has a relatively simple processor design, IDT's chips have been behind in clock speed. The original WinChip was shipped primarily at 180 and 200 MHz, with 225- and 240-MHz versions shipping this past spring. The WinChip 2 is due to enter production soon after this story appears, with clock speeds of up to 266 MHz. A 300-MHz version is expected this fall.

IDT has aggressive plans to continue enhancing the WinChip line. In early 1999, the WinChip 2+ will have twice as much L1 cache as the WinChip 2—an approach IDT says offers most of the benefit of adding an L2 cache, with a much lower manufacturing cost. By mid-1999, IDT plans to roll out the WinChip 3, a new design that uses a technique called *superpipelining* to double the clock speed. And in the second half of 1999, IDT plans to introduce the WinChip 2+NB, integrating the "north bridge" part of the system-logic chip set on the processor. The north bridge interfaces the processor with the PCI bus, DRAM, AGP, and L2 cache. This combination eliminates the processor bus, giving the chip high-speed access to the L2 cache and DRAM.



BUS WARS

All of Intel's competitors use the Socket 7—or Pentium—bus interface (including AMD's 100-MHz version of the Socket 7 interface, called Super 7). Intel, however, has moved its entire desktop product line to the Slot 1, or Pentium II, bus interface.

The most important thing about the Slot 1 module is not its bus, however, but the fact that it provides room for L2 cache RAM as part of the processor module, connected via a dedicated link. This gives the Pentium II processor much greater L2 cache bandwidth than any Socket 7 system. Non-Intel chips, on the other hand, will integrate more cache on the CPU chip—256K L2 in the case of AMD's K6-3, or a larger L1 for IDT's WinChip 2+—to gain the cache bandwidth benefit of Slot 1 while sticking with the Socket 7 interface.

Of course, Slot 1 and Socket 7 systems require different system logic chip sets. The bottom line: A bus is only as important as the performance it delivers. Unless you are interested in swapping in different processors (in which case a Socket 7 system offers the greatest flexibility), keep your buying decision focused on price and performance.

IA-64 AND MERCED

Although it is still two years away from first shipments, Intel's Merced processor, the first chip to implement the new IA-64 architecture, is getting a lot of attention. The IA-64 architecture includes a new 64-bit instruction set developed jointly by HP and IBM and is also capable of running *x*86 software natively. An impressive list of companies—nearly every major computer maker except Sun Microsystems—has signed up to build IA-64 systems, ranging from workstations to enterprise servers. But PC buyers will have an even longer wait before IA-64 becomes relevant to

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BENCHMARK TESTS

CPUs

PC MAGAZINE LABS

Intel maintains its lead for sheer processor power, and its Pentium II is the best choice for 3-D; AMD and Cyrix processors are great values for users who are concerned with mainstream applications.

In the race for processor power, Intel still has a commanding lead. The Pentium II processors are out in front, with faster clock speeds and more powerful floating-point units (FPU). For business applications, the AMD K6-2 and Cyrix MII perform on a par with the Pentium II processors at the same speed. For FPU performance (FPU is now used in few mainstream applications but is a significant component of 3-D games), Intel provides the best performance. The new 3DNow! extensions, however, are a compelling alternative for high-performance game development.

In testing with beta graphics drivers and beta DirectX 6.0, the K6-2 came close to the Pentium II's performance. Once drivers and DirectX 6.0 are fully optimized, you should expect the K6-2 to give you a slight performance advantage over the Pentium II for gaming applications. Those games that use 3DNow! instructions for physics calculations, in addition to geometry calculations, will benefit further.

ZD Business Winstone 98 is a measure of overall system performance while running typical business applications. By holding subsystems like the hard disk, graphics card, and memory type and speed constant, Business Winstone becomes a good gauge of CPU performance. The higher clock speed and faster cache of the Pentium II systems proved to be the deciding factors. The Pentium II systems with clock speeds greater than 300 MHz were the top performers. The AMD K6-2/300 did well, scoring on a par with the Pentium II/300. The Cyrix MII/300 fell a bit off the pace, scoring about 12 percent lower than the 300-MHz Pentium II and K6-2. Lacking L2 cache, the two Celeron processors scored nearly the same as the Pentium MMX/233—more than 30 percent behind the Pentium IIs.

ZD CPUmark$_{32}$ tests the integer performance of a processor, its cache, and memory. Performance results paralleled those achieved on Winstone 98, with only minor differences. The 100-MHz bus on the K6-2/300 again put it on a par with the Pentium II/300, but the K6-2/266 fell further behind the Pentium II/266: Its score was 15 percent lower.

With a slower core processor speed of 233 MHz, the Cyrix MII/300 trailed the Pentium II/300 by 33 percent. Even with this comparatively low score, the MII/300 still outperformed the Pentium MMX/233 and the two Celeron processors that typically compete in the same price class. The Pentium MMX score was 11 to 15 percent higher than the Celerons' score.

To test each CPU's floating-point unit, we used three tests. The Synthetic Floating Point test is a direct measure of a CPU's floating-point capabilities. The 3D WinBench Processor test runs the standard 3D WinBench suite but without rendering the output to the screen, thus measuring the CPU's ability to handle the transform and lighting tasks without involving the graphics card's 3-D rendering engine. Finally, we applied the Photoshop Lighting Effect filter, which uses floating-point calculations to achieve its effect.

On the Synthetic Floating Point test, Intel's strong FPU really stood out. The Pentium II–based processors, including the Celeron systems, took all the top spots. The deciding factor among Pentium II–based processors was clock speed. Next came the AMD, Pentium MMX, and Cyrix chips. Although AMD has added SIMD (Single Instruction Multiple Data) FPU performance in the K6-2 3DNow! extensions, its standard FPU is still the same as that on the K6. Cyrix has always focused on mainstream application performance and left FPU performance to Intel, and this is supported by our test results: The MII/300 score was 39 percent lower than the nearest competitor, the K6-2/266, and 58 percent lower than the lowest-scoring Pentium II, the Celeron 266. Currently, strong FPU performance is not critical for most mainstream applications; you will notice a difference under 3-D games, however.

The 3D WinBench Processor test produced results that were almost exactly the same as those of the Synthetic Floating Point test. The only difference was a flip-flop of the Celeron 300 and the Pentium II/266, with the Pentium II coming out on top. This slight difference in performance occurred because 3D WinMark benefits from the presence of L2 cache in the Pentium II/266.

We also found similar results among processors on the Photoshop Lighting Effect filter test. Since this is an application-based test, performance is not attributable solely to FPU; integer calculations and graphics performance also factor into results. Our relatively small file sizes helped to reduce disk activity, allowing more focus on CPU performance. The K6-2 chips were able to do a little better on this test than on the Synthetic Floating Point test but still could not match the Pentium II processors.

To test the new 3DNow! multimedia extensions in the AMD K6-2 chips, we ran a matrix of tests using 3D WinMark, the game Forsaken (which contains 3DNow! code), DirectX 5.0, and DirectX 6.0. (We tested using a beta version of DirectX 6.0; a final version should be available by the time you read this.) We limited testing to the 266- and 300-MHz versions of the Pentium II and K6-2 processors.

We ran Forsaken with DirectX 5.0 and the standard driver as a control. On the Forsaken tests, the Pentium II chips clearly led the rest of the field. Then we obtained a beta version of a driver from nVidia that contains K6-2 optimizations. These provide data-

Bold type denotes first place	Bus Speed MHz	ZD CPUmark$_{32}$ Score
AMD K6-2/266	66	582
AMD K6-2/300	100	763
Cyrix MII/300	66	512
Intel Celeron/266	66	372
Intel Celeron/300	66	384
Intel Pentium MMX/233	66	430
Intel Pentium II/266	66	685
Intel Pentium II/300	66	770
Intel Pentium II/333	66	848
Intel Pentium II/350	100	893
Intel Pentium II/400	100	1,020

BETTER ▶

▲ **With a slower core processor speed of 233 MHz, the Cyrix MII/300 trailed the Pentium II/300 by 33 percent. Thus we see that Cyrix's PR ratings, which are Intel-equivalent clock speeds instead of the actual speed, hold true for overall system performance but not for CPU performance alone.**

Bold type denotes first place.	Bus Speed MHz	ZD Business Winstone 98 Score
AMD K6-2/266	66	20.4
AMD K6-2/300	100	23.4
Cyrix MII/300	66	21.3
Intel Celeron/266	66	17.0
Intel Celeron/300	66	17.4
Intel Pentium MMX/233	66	17.5
Intel Pentium II/266	66	22.3
Intel Pentium II/300	66	23.8
Intel Pentium II/333	66	24.6
Intel Pentium II/350	100	25.7
Intel Pentium II/400	100	28.2

BETTER ▶

▲ **You can see the effect of the 100-MHz system bus on the AMD processors when you compare the results of the two K6-2 entries. The K6-2/300, running on a 100-MHz bus, kept pace with the Pentium II/300, while the K6-2/266, running on a 66-MHz bus, lagged behind the Pentium II/266 by 9 percent.**

transfer efficiencies and increased concurrency for data reads and writes to and from system memory, processor cache, and the graphics adapter. The driver was not fully optimized for performance at the time of testing and could provide greater benefits in the future. Using the beta driver, and with the registry set to recognize a 3DNow!-capable processor, the AMD K6-2 chips' performed better but still not at the level of the Pentium IIs: The K6-2s gained 4 to 5 frames per second, but the Pentium IIs, as expected, gained nothing.

We also ran 3D WinMark, which is not 3DNow!-enabled, in a configuration similar to the Forsaken tests. When we tested using DirectX 5.0 as a control, the Pentium II chips were again the leaders. The K6-2/300 CPU tied the Pentium II/300 CPU when using the driver provided by STB with the registry processor ID enabled. The K6-2 chips showed gains of over 30 percent when the registry was set to recognize the K6-2 processor.

PC Magazine Labs developed a Video Encoder test using the RealNetworks G2 RealVideo Encoder to encode an AVI file into a RealVideo file. With the encoder, we see the effect of MMX code in a real-world application. Although the test does use MMX code, it apparently relies on the standard FPU as well, because the results were nearly identical to those of our Synthetic Floating Point tests: The Pentium II–based chips took all the top spots.

How We Tested

We used machines with configurations as close to identical as possible in order to isolate CPU performance. The Pentium II processors were run on Intel 440BX motherboards, the Celeron processors on Intel 440LX motherboards, and the Socket 7 processors (AMD K6-2, Cyrix MII, and Pentium MMX) on TMC TI5VG+ motherboards using the VIA MVP3 chip set and 512K of L2 cache. We ran all tests with 64MB of 100-MHz SDRAM. We set the resolution to 1,024-by-768 with 24-bit color for all tests except the Forsaken tests. Each system had a Seagate Medalist Pro ST39140A, a 9.1GB EIDE 7,200-rpm hard disk, and an STB Velocity 128 graphics card based on the nVidia RIVA 128ZX chip set with 8MB of on-board frame-buffer RAM. We used nVidia's 3DNow!-enhanced driver for 3-D testing under DirectX 6. In all cases, we tested the systems with Windows 98.

We used our benchmark test program **ZD Winstone 98** to measure overall performance on all processors. Winstone 98 is divided into two parts: ZD Business Winstone 98, focusing on mainstream applications, and ZD High-End Winstone 98, emphasizing CPU and graphics-intensive applications. We ran only our Business Winstone 98 tests, which measure the time a PC takes to execute a set of scripts that exercise nine of the best-selling Windows 95 applications. Business Winstone 98 weights a PC's test timings based on the applications' unit market shares; it derives a composite number and converts that to a relative score. (The score is relative to the performance of a Dell Dimension Pentium/133 with 32MB of RAM, at 1,024-by-768 resolution with 16-bit color, running Windows NT 4.0 with Service Pack 3. The base score is defined as 10.)

ZD WinBench 98 measures a system's graphics, disk, CPU, CD-ROM, and full-motion video performance under Windows 95/Windows 98; for this roundup, we ran only the CPU test. The **CPUmark$_{32}$** score gauges the speed of a PC's processor subsystem, which includes the CPU, primary and secondary cache, and system RAM,

		ZD 3D WinMark 98				Forsaken			
High scores are best. Bold type denotes first place.	Bus speed (MHz)	DX5 and STB driver with 3DNow! (score)	DX6 and STB driver without 3DNow! (score)	DX6 and STB driver with 3DNow! (score)	DX6 and nVidia driver without 3DNow! (score)	DX6 and nVidia driver with 3DNow! (score)	DX5 and STB driver (frames per second)	DX6 and STB driver without 3DNow! (frames per second)	DX6 and STB driver with 3DNow! (frames per second)	DX6 and nVidia driver without 3DNow! (frames per second)	DX6 and nVidia driver with 3DNow! (frames per second)
AMD K6-2/266	66	340	466	672	460	628	49.0	48.0	48.4	44.2	49.9
AMD K6-2/300	100	393	640	**799**	496	655	50.0	54.6	50.4	47.6	51.1
Cyrix MII/300	66	262	N/A	N/A	N/A	N/A	48.2	N/A	N/A	N/A	N/A
Intel Celeron/266	66	436	N/A	N/A	N/A	N/A	48.1	N/A	N/A	N/A	N/A
Intel Celeron/300	66	469	N/A	N/A	N/A	N/A	50.1	N/A	N/A	N/A	N/A
Intel Pentium MMX/233	66	344	N/A	N/A	N/A	N/A	49.4	N/A	N/A	N/A	N/A
Intel Pentium II/266	66	565	740	735	725	720	51.8	52.7	52.6	51.3	51.8
Intel Pentium II/300	66	628	**797**	**799**	**782**	**781**	53.0	**55.5**	**54.1**	**54.4**	**54.8**
Intel Pentium II/333	66	679	N/A	N/A	N/A	N/A	**56.3**	N/A	N/A	N/A	N/A
Intel Pentium II/350	100	721	N/A	N/A	N/A	N/A	65.4	N/A	N/A	N/A	N/A
Intel Pentium II/400	100	**790**	N/A	N/A	N/A	N/A	54.6	N/A	N/A	N/A	N/A

N/A—Not applicable. We ran these tests only on 266- and 300-MHz Pentium II and K6-2 systems. DX5—DirectX 5.0. DX6—DirectX 6 Beta. STB driver—A non-3DNow! driver supplied by STB. nVidia driver—A Beta 3DNow!-enabled driver from nVidia, Version 4.10.250. With 3D Now!—This test was run with the registry key that identifies the processor enabled. Without 3D Now!—This test was run with the registry key that identifies the processor disabled.

▲ **Interestingly, even without the help of 3DNow! instructions built into 3D WinMark core code, the K6-2 chips showed improvements when we enabled the registry to identify 3DNow! processors. That's because 3D WinMark uses DirectX–6 transform and lighting modules, which are 3DNow!–enabled.**

under 32-bit operating systems. CPUmark$_{32}$ emulates the CPU activity of real-world 32-bit applications.

We used 3D WinMark 98 to evaluate 3-D graphics performance and to assess a system's ability to execute certain 3-D rendering features. We first perform the 3D Quality test to deter-

BENCHMARK TESTS

▲ High scores are best. ▼ Low scores are best. Bold type denotes first place.	Bus speed MHz	Floating Point Tests: Synthetic Floating Point Score ▲	Floating Point Tests: ZD 3D WinBench 98: Processor Score ▲	Floating Point Tests: Photoshop: Lighting Effect Minutes:seconds ▼	MMX Tests: Photoshop: Gaussian Blur Seconds ▼	MMX Tests: Photoshop: Unsharpen Mask Seconds ▼	MMX Tests: Video Encoder Minutes ▼
AMD K6-2/266	66	866	332	2:40	46.3	34.2	20
AMD K6-2/300	100	979	356	2:24	41.4	31.2	20
Cyrix MII/300	66	527	261	3:22	54.8	36.8	30
Intel Celeron/266	66	1,240	426	2:28	44.0	35.8	17
Intel Celeron/300	66	1,390	466	2:32	42.2	34.3	16
Intel Pentium MMX/233	66	900	337	3:19	57.2	36.2	25
Intel Pentium II/266	66	1,370	545	2:27	44.1	35.2	16
Intel Pentium II/300	66	1,540	599	2:14	42.6	36.2	14
Intel Pentium II/333	66	1,700	645	2:06	41.7	35.7	13
Intel Pentium II/350	100	1,790	683	1:59	38.2	33.1	12
Intel Pentium II/400	100	2,050	752	1:48	36.1	30.8	11

▲ By adding a second MMX unit to the K6-2, AMD was able to match Intel's performance. The K6-2/300, with its 100-MHz system bus, came in ahead of the Pentium II/300 on both Photoshop filter tests—the Gaussian Blur test and the Unsharpen Mask test. The K6-2/266 (with a 66-MHz system bus) also beat all the Pentium II units except the 350- and 400-MHz Pentium II CPUs (which have 100-MHz buses) on the Unsharpen Mask test.

mine which of the 25 tested features the graphics card supports (the results are not charted). We then run the performance portion of 3D WinBench 98 to obtain the various **3D WinMark 98** scores. The test is made up of 19 scenes; each scene is rendered by hardware if the 3D Quality test shows that the graphics card supports the needed features. If not, the scene is rendered in software. We installed DirectX 5.0 before running the test matrix. We also used a beta copy of DirectX 6.0 for certain test runs. The new DirectX 6.0 contains support for 3DNow! Finally, for some test runs, we set a switch in the registry which turned the ability to identify the processor and its support of 3DNow! on or off.

We also used 3D WinBench as a **Processor** test, setting the test parameters to run the standard 3D WinBench but not render the output to the screen. This measures the CPU's ability to handle the floating-point intensive geometry and lighting tasks without adding in the graphics card's 3-D rendering engine.

Ed Henning, director of ZD Labs, Europe, developed our **Synthetic Floating Point** test, which consists of five algorithms to solve Poisson's equations, fast Fourier transform (FFT), calculation of planetary orbitals, calculation of areas of polygons, and a Gauss-Jordon elimination-of-coefficient matrix of linear equations. The algorithms are weighted to reflect real-world usage and yield a single score.

Various filters in Adobe Photoshop 4.01 were used to test MMX and floating-point performance. We used the primarily integer-based **Gaussian Blur** and **Unsharpen Mask** filters to test MMX processing, and we used the **Lighting Effects** filter to test floating-point processing. We used a 15MB image for all tests to reduce disk activity substantially. The Gaussian Blur filter was applied with the radius value of 1.0. We ran Photoshop's internal timers to measure the elapsed time for all tests.

To test the new 3DNow! multimedia extensions in the AMD K6-2 chips, we ran a matrix of tests using the game **Forsaken** under DirectX 5.0 and DirectX 6.0. (We used DirectX 6.0 in a beta version; a final version should be released by the time you read this.) All tests were run at 800-by-600 resolution, and we limited testing to the 266- and 300-MHz versions of the Pentium II and K6-2. We ran Forsaken's demo and used its built-in frame counter to get our results. We also ran Forsaken with DirectX 5 and the standard graphics card driver supplied by STB as a control, then ran DirectX 6.0 and a beta version of a driver from nVidia that contains K6-2 optimizations for the RIVA 128ZX chip set on the STB card. For some tests, we set the registry to recognize the processor and its support of 3DNow!

PC Magazine Labs developed a **Video Encoder** test using the RealNetworks G2 RealVideo Encoder to encode an AVI file into a RealVideo file. The encoder uses MMX instructions and is a good example of a real-world MMX application beyond image-editing software.

them. Merced initially will appear mostly in systems selling for more than $10,000—often much more. By 2002, sub-$5,000 Merced PCs are likely, and in 2003 or 2004, they could reach the mainstream PC market.

MOBILE

Until early this year, Intel had the mobile processor market to itself. None of Intel's competitors was able to deliver chips with power consumption low enough for a notebook computer. Mobile Pentium MMX remains popular in notebooks—the only market where Intel continues to support the older CPU—and Intel finally added Pentium II as a mobile option in April.

The first big win for an Intel alternative in a top-tier notebook computer came when Compaq added a model in January based on Cyrix's MediaGX. Compaq also offers notebooks based on AMD's K6. IDT hopes to make inroads in the notebook market with its WinChip.

THE FUTURE: MORE *x*86 Vendors

At least one more competitor will join the PC microprocessor market this year, and two or three more are likely to throw their hats into the ring next year. Rise Technology, a start-up based in Silicon Valley that has been designing an *x*86 processor for several years, has begun sampling early silicon. Rise will disclose the chip design at Microprocessor Forum in October (*www.mdronline.com/mpf*). The company is expected to focus on the low-cost PC market.

In 1997, STMicroelectronics (formerly SGS-Thomson and an early partner of Cyrix) acquired design house Metaflow Technology. Rumor has it that the company's high-performance *x*86 processor will be offered in a slot 1 module.

A secretive start-up named Transmeta has been working for about two years on a CPU for PCs, which is rumored to have its own internal instruction set but to use a fast software translator to execute *x*86 instructions. Transmeta has raised a large (undisclosed) amount of venture capital and is well staffed; a product debut is likely in 1999. PC

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Innovations in desktop image editing and illustration are expanding the palette for design professionals.

By Sally Wiener Grotta and Daniel Grotta

professional graphics

GRAPHICS SOFTWARE IS ONE OF THE HOTTEST GROWTH AREAS IN computing. Image-editing and illustration programs are now called upon to create projects for a variety of media—from print to the Web, and in a variety of formats—from Web-page buttons to billboards. To meet these challenges, graphics vendors have been expanding their programs' repertoires, adding increased use of image layers, better multiple undos, vastly improved color management, integrated Web graphics tools, and enhancements that boost productivity. Together these developments open up new possibilities for design professionals.

This year's review of professional graphics software covers ten products in two categories: image editing and illustration. To test image-editing software, we looked at three key areas: photo editing, compositing (combining or collaging two or more images), and painting. Our illustration software tests focused on artistic and technical drawing. In addition, in both categories, we tested each program's print and Web output abilities.

Image Editing

Adobe Photoshop 5.0 156
Corel Photo-Paint 8 166
Painter 5 172
Picture Publisher 8 178
OFX 6.25 180
Wright Design 2.0 181

Illustration

Adobe Illustrator 8.0 (beta) 184
Canvas 5.0.3 189
CorelDraw 8 191
FreeHand 8 195
Editors' Choice 153
Add-On Infinitum 177

ILLUSTRATIONS BY KIP HEYNEN

Color

Although it sounds like a simple issue, color can be quite complex. The reason is that different devices, such as scanners, monitors, and printers, each have different ways of producing color, so that what you see on screen is not necessarily what you get in print. To fix this, graphics programs rely on a color-management system, or CMS. Many programs now integrate support for standard ICC (International Color Consortium) device profiles. The result is more reliable color.

Layers & Objects

Layers and objects have become standard features in graphics software. The advantage of using layers is that you can combine multiple images and add new elements, such as brushstrokes, to projects without permanently changing the original images. Because objects on layers can be edited or removed, you can experiment freely without fear of ruining an image or losing your work.

Web Graphics

As a graphics medium, the Web poses unique demands. Most graphics programs a can import and export GIF, JPEG, and PNG formats. Other features to look for include the ability to reduce graphics from photo-realistic, 24-bit color to Web-friendly 8-bit color and the ability to create image maps.

Vector Graphics a

The forte of illustration packages, vector graphics offer several advantages. First, vector graphics can be magnified or reduced without any loss of detail. Second, they tend to be smaller than bitmap files, so vector graphics are well-suited to the Web.

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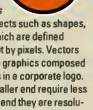
By Sally Wiener Grotta and Daniel Grotta

Image Editing vs. Illustration

In technical terms, image-editing programs are designed to work primarily with bitmapped images, and illustration programs are designed to handle vector graphics.

A *bitmapped image* (also known as a *raster image*) is made up of an array of thousands or millions of small squares called *pixels*. Bitmaps are typically used for photographs or painted images. The disadvantages of bitmapped graphics are that (1) they usually require more system resources, and (2) they are resolution-dependent, so that when magnified they appear jagged.



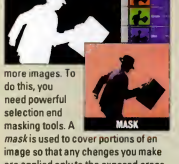


Vector graphics are made up of objects such as shapes, lines, and fonts, which are defined mathemetically, not by pixels. Vectors are better suited to graphics composed of basic shapes, as in a corporate logo. They tend to be smaller and require less system resources, and they are resolution-independent, so they can be shrunk or magnified with no loss of detail, as the magnified inset shows.

Selections, Masks, and Alpha Channels

One of the more common tasks in an image-editing program is creating a composition from two or more images. To do this, you need powerful selection and masking tools. A *mask* is used to cover portions of an image so that any changes you make are applied only to the exposed areas. Masks are often saved in an alpha channel, a channel that stores noncolor information about an image.





To create the composite image shown in our first example, we had to cut the man from the original image

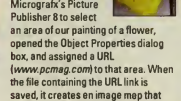


and place him in our project. The dotted line that surrounds the men shows the area that has been selected. Image-editing programs include tools for making regularly shaped selections, such as rectangles and ovals, and free-form selections using pens and other tools.

An *alpha channel* is a separate, gray-scale channel that is saved with an image's color channels. (In this example, we are using an RGB image, so the color channels are red, green, and blue.) When you add a mask to an alpha channel, it works like a cardboard stencil that you might place over a picture to outline areas that you want to work on (as shown).

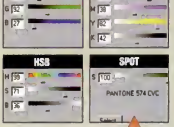
The black and white areas on an alpha-channel mask represent fully opaque and fully transparent areas, respectively, and levels of gray represent varying degrees of translucency. In the next example, we placed a gradient mask that goes from black to white—with grays in between—on the alpha channel of the image of the sky. Then, when we selected the areas that showed through the mask and pasted them onto the image of the bottles, it created a gradual transition from the sky to the bottles.

Web Graphics



Many graphics programs let you select objects or areas in an image and create hot spots, areas that link to the URL of a Web site. In this example, we used Micrografx's Picture Publisher 8 to select an area of our painting of a flower, opened the Object Properties dialog box, and assigned a URL (*www.pcmag.com*) to that area. When the file containing the URL link is saved, it creates an image map that defines the area of the image that has been assigned as a hot spot. When the file is viewed within a Web browser, the cursor turns into a pointing hand to indicate that you can click on this area to jump to *PC Magazine*'s Web site.

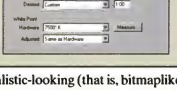
Color Models



Color is described in scientific terms by using color models. In these models, any color is described as a mixture of primary colors. RGB (which is the model best suited for computer screens) mixes red, green, and blue. CMYK (the model most often used for printing) uses cyan, magenta, yellow, and black. Other color models include CIE Lab, HSB, and spot colors, such as Pantone or Trumatch. In the example here, we show how a single color is represented using several different color models.

Color Management

To ensure that what you see on-screen is what you get in print, color management is critical. Color management produces color all the way from scanners and digital cameras to the screen to printers, color proofers, and image setters. The International Color Consortium (ICC) has established a standard for creating profiles. In this example, we created an ICC profile for our monitor in Photoshop.



Our story takes in all the usual suspects—including products from Adobe and Corel—with one exception: Macromedia's xRes (Macromedia has not updated xRes in a year). Adobe was still working on the next version of Illustrator during our testing cycle; the final version should be available in September. We tested an early beta of Illustrator 8.0 for this roundup.

Traditionally, image-editing and illustration programs have occupied separate worlds. Image editors were designed for bitmap images such as photographs, while illustration packages were object-oriented tools used for vector graphics. But these distinctions aren't so clear-cut anymore. For instance, image-editing programs now feature better text-handling and layout tools. Similarly, illustration programs are becoming more detail-oriented, allowing the use of colors and effects to produce more realistic-looking (that is, bitmaplike) images. Two products, Deneba's Canvas 5.0.3 and Wright Design 2.0, straddle both categories and throw in some page layout tools to boot.

Layers and objects—once the domain of illustration packages only—have now become the standard in image-editing programs as well. The advantage of using layers is that you can add new elements such as brushstrokes to projects without





editors' choice

- **Image editing: Adobe Photoshop 5.0**
- **Illustration: CorelDraw 8**

PC MAGAZINE EDITORS' CHOICE

The term "professional graphics" covers a lot of ground. Designers use graphics software to prepare existing images for print or the Web, illustrators use these packages to create original works of art, and engineers and architectural designers rely or illustration programs to draft 2-D models. With all these applications, choosing the best products was no easy task.

In the image-editing category, Adobe Photoshop 5.0 is our program of choice this year. Photoshop excels in the two areas that we feel are most important to the majority of design professionals: image editing (or photo editing) and compositing—the process of combining elements from two or more images to create a new image. This new version of Photoshop also includes some major new features users have been clamoring for including multiple undo and redo using the History palette, better text handling, Layer Effects, and integrated ICC (International Color Consortium) support.

Photoshop is still not perfect. Its painting tools are adequate, but they can't match those of Corel Photo-Paint 8 and MetaCreations' Painter 5. And Photoshop's Web graphics features are minimal compared with those of Photo-Paint and Micrografx's Picture Publisher 8. (Adobe's answer for Web graphics is a separate product called ImageReady.) Picture Publisher earns an honorable mention in this category for its Web graphics tools, and Painter gets an honorable mention for its unique natural-media painting capabilities.

In our illustration category, CorelDraw 8 was the only product capable of doing everything, making the software our current choice for creating vector graphics. CorelDraw earned above-average scores on all four of our illustration tasks: artistic illustration, technical illustration, print output, and Web output.

This version of CorelDraw includes several usability enhancements, most notably the ability to apply and edit drop shadows and distortion effects directly using drag-and-drop operations. A new Palette Editor lets you create and edit custom color palettes. CorelDraw also includes a decent set of technical illustration tools. Finally, the program's print output has improved significantly, and its Web tools are thorough and well integrated.

Although we did not consider Adobe Illustrator 8.0 for Editors' Choice because it was still in beta during our testing, this new version looks very promising. Macromedia's FreeHand 8 offers the best Web tools, including Flash animation, and Deneba's Canvas 5.0.3 earns high marks for technical illustration.



affecting the underlying images. Because graphical elements on layers can be edited or removed, you can experiment freely without fear of ruining an image or losing your work. Not all image-editing packages take the same approach to layers. Micrografx's Picture Publisher 8 and Ron Scott's QFX 6.25 use layers or objects for compositing but not for painting. At the opposite extreme, Wright Design defines everything, even brushstrokes, as objects that are filled with layers.

Basic image-editing functions, such as controls for adjusting color, exposure, and focus—or for applying special effects—reached a level of maturity years ago. Advances in this area are now related more to how effects are applied and whether they can be changed easily later. Currently Adobe Photoshop 5.0, Corel Photo-Paint 8, MetaCreations' Painter 5, and Wright Design are taking advantage of layer technology to add reeditable objects that apply effects to underlying layers, such as drop shadows on text. We expect these productivity-enhancing tools to become even more prevalent in coming years.

This year, it seems that graphics vendors have placed as much emphasis on being able to undo things as they have on actually doing them. Photoshop's History palette, Photo-Paint's Undo list, and Picture Publisher's Command Center all save recent changes to an image so that you can skip back to a previous version. But not all undos are created equal. Photoshop's History palette cannot be saved with the image or as a separate file (although periodic snapshots can be archived). Picture Publisher's list lets you return to a previous change, such as a filter or a hue shift, and adjust its parameters—something neither Photoshop nor Photo-Paint supports. Photo-Paint also does not permit branching (or nonlinear editing) using the Undo list. And only Photoshop has a History Brush, which allows users to paint selectively from a previous version of an image onto the current version.

Illustration programs are also getting tools that encourage greater experimentation and creativity. Drawing tools such as Macromedia FreeHand 8's Freeform push-and-pull tool and Adobe Illustrator's new Pencil are more intuitive than

Our Contributors: SALLY WIENER GROTTA, DANIEL GROTTA, JAN OZER, and LUISA SIMONE are contributing editors of *PC Magazine*. WILL FASTIE is a frequent contributor, and MATTHEW GRAVEN is a staff editor of *PC Magazine*. DIANE JECKER was the project leader, and JOHN MORRIS was the associate editor in charge of this story.



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the traditional Bezier tool. CorelDraw 8's Lens Effects and FreeHand's transparency options greatly enhance an object, and other bitmaplike effects, such CorelDraw's texture fill, lend near-photorealism to illustration.

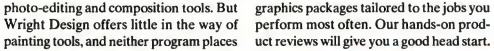
Last year, we reported that color management was still problematic on the PC. This year, we're happy to report that color management is greatly improved, thanks to better support for ICC (International Color Consortium) profiles. ICC is a standard for writing hardware device profiles to ensure that the color you see on-screen matches what you get in print. Apple's ColorSync and Microsoft ICM 2.0 (Image Color Management) are based on the ICC standards. Software and hardware vendors are already taking advantage of ICC, fine-tuning the profiles for optimal output. The results are astonishing. For example, Picture Publisher's color is now right on. Photoshop's print quality is still the finest, but on our tests, its color fidelity was average.

Because these programs were initially designed for print and prepress, the Web graphics features vary greatly. Most programs allow you to reduce 24-bit photorealistic images to 8-bit images that are appropriate for the Web. But Photo-Paint and Picture Publisher currently offer the best integrated Web tools. You can convert objects into hot spots by simply entering the target URLs in their Properties dialog boxes. Both allow you to generate client- and server-side image maps. When downsampling images to indexed (8-bit) color, Picture Publisher provides previews plus download estimates, and the images it produced looked best in our browser.

Other programs such as Photoshop, QFX, and Wright Design rely on separate utilities for Web graphics features. Adobe has created a separate program, ImageReady, which can be used with Photoshop or as a standalone program. In fact, Web graphics have become so important that a separate image-optimization and automation category has emerged. In addition to ImageReady, this new category includes standalone programs such as Macromedia's FireWorks and Equilibrium's DeBabelizer Pro, plug-ins such as Digital Frontiers HVS Color, and even online optimizers such as Raspberry Hill's GIF Wizard. Although we'd prefer to see these Web tools integrated with mainstream image-editing programs—as Corel and Micrografx have done—these companion tools are certainly a viable alternative.

Perhaps graphics software as a category is growing a little too fast. Most of the products we looked at are having trouble keeping up in all these growth areas, and no one program excels at everything. Photoshop and Wright Design offer the best photo-editing and composition tools. But Wright Design offers little in the way of painting tools, and neither program places much emphasis on Web features. Picture Publisher is great at Web graphics but mediocre in other areas. Illustrator and FreeHand excel at artistic illustration—and FreeHand has some great Web features—but both are lacking in technical illustration tools. Corel's products probably come closest to addressing all areas, but Photo-Paint still has some problems to resolve in the critical area of compositing.

Therefore it is important to pick the graphics packages tailored to the jobs you perform most often. Our hands-on product reviews will give you a good head start.



Adobe Photoshop 5.0

$650 street (upgrade from any version, $200; upgrade from Photoshop LE, $300). Adobe Systems Inc., San Jose, CA; 800-492-3623, 408-536-6000; www.adobe.com; 501 at www.pcmag.com/infolink.



With the release of Photoshop, Adobe helped invent the desktop imaging market, but in recent years it seemed as if Adobe had left innovation to its competitors. That is, until the release of Photoshop 5.0, one of the more significant upgrades to come from Adobe in years. Among the many improvements in this version are multiple levels of undo and redo, enhanced text handling, better color management, and new productivity tools. Photoshop 5.0's painting tools are only average and Web features are minimal, but when you combine its new features with the best output in the business, it remains the benchmark.

Perhaps the single most important advance in Photoshop 5.0 is the History palette, which maintains a list of all recent actions so that you can backtrack to any previous stage in the editing process. Along the way, you can take snapshots of your project.

When using the History palette, you can either delete specific steps or undo steps; the latter functions like a one-click multiple undo, deactivating all subsequent steps. You can't return to a step and change its parameters. However, you can configure the History palette for nonlinear editing so that you can return to a prior version of your project and undo that step without sacrificing subsequent edits. You can't save the history with the image, but you can save snapshots.

The History Brush can be used to paint the contents of a prior version of the image onto the current version. For example, you can apply a Gaussian Blur to your entire picture, remove it, and then use the History Brush to paint the Blur onto selected areas only.

Photoshop 5.0 also addresses some long-standing complaints about the program's text tools, adding tracking, kerning, leading, and baseline shift. Each character can be a different size and font, but color applies to the entire text block. The new vertical type tool is so useful that it is hard to imagine how users ever functioned without it.

The new Layer Effects feature makes it easy to add shadows, glows, bevels, and embossing to text or to any other item that resides on its own layer. Each time you make a change to that layer, the effects are automatically updated. For example, if you move text, its shadow will move with it. And the effects remain editable.

In addition to a proprietary color-management system, Adobe has added support for device profiles based on the ICC standard. This version of Photoshop supports sRGB, a proposed standard that would eliminate the need to profile each monitor separately. Users would still need ICC profiles or other color management systems across the entire workflow.

The core tasks of image editing are photo editing and compositing. In these

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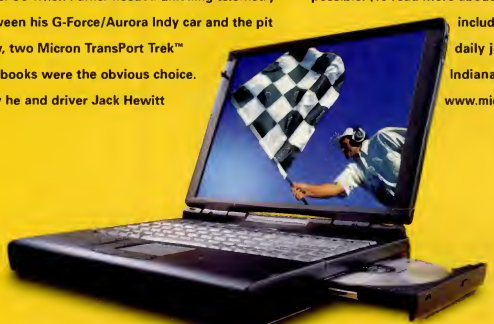
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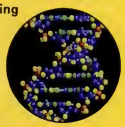
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- 100MHz front side Bus
- 3.5" floppy drive
- Integrated Symbios PCI Ultra Wide SCSI-3 dual channel controller
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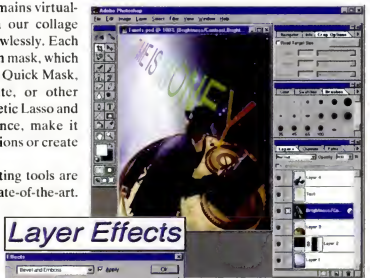
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areas, Photoshop remains virtually unparalleled. On our collage test, it performed flawlessly. Each layer can have its own mask, which can be created using Quick Mask, the Channels palette, or other methods. New Magnetic Lasso and Pen tools, for instance, make it easier to make selections or create clipping paths.

Photoshop's painting tools are serviceable but not state-of-the-art. You can design new brushes and use stylus pressure to alter color, opacity, and size. Also, with the ability to create empty layers, no stroke need be permanent. However, the included brushes pale in comparison with those in Corel Photo-Paint 8 and MetaCreations' Painter 5.



Although Adobe Photoshop 5.0 boasts many new features, the interface is essentially the same. (A) Layer Effects. (B) The History palette provides multiple undos.

Web graphics is another area in which Photoshop left us wanting more. While Photoshop has a transparent GIF export wizard and the ability to create custom palettes for indexed images, you can't create hot spots or image maps, and Photoshop doesn't generate average palettes. Rather than integrating Web features into Photoshop, Adobe has introduced a separate product, ImageReady, which adds these features.

Photoshop's print output continues to be the best, with smoother, cleaner lines and less pixelization (excluding text) than in other programs. The dynamic range is also good, though leaning toward dark, but the program's color matching was subpar on our tests.



Corel Photo-Paint and Painter offer better painting tools, and Picture Publisher integrates more Web graphics features, but Photoshop is still the one to beat when it comes to the key areas: image editing, compositing, and crisp output. New features in Photoshop 5.0 should satisfy its many users and keep the program on top for some time to come.—*Sally Wiener Grotta and Daniel Grotta*

suitability to task: image editing

POWER	Adobe Photoshop 5.0	Corel Photo-Paint 8	Painter 5	Picture Publisher 8	QFX 6.25	Wright Design 2.0
Photo Editing	Excellent	Excellent	Fair	Good	Fair	Excellent
Compositing	Excellent	Good	Fair	Good	Fair	Excellent
Painting	Good	Excellent	Excellent	Fair	Fair	Fair
Web Graphics	Fair	Good	Poor	Excellent	N/A	N/A
EASE						
Photo Editing	Excellent	Excellent	Good	Excellent	Fair	Excellent
Compositing	Excellent	Good	Fair	Good	Fair	Excellent
Painting	Good	Excellent	Good	Fair	Fair	Excellent
Web Graphics	Good	Excellent	Fair	Excellent	N/A	N/A

N/A—Not applicable. The product does not have this feature.

Photo editing is the process of perfecting an image and includes such features as tonal controls (exposure and dynamic range), color balance and hue shift, focus, filters, and cloning. For adjusting exposure, there should be a gamma curve, a histogram, and a contrast/brightness tool, and edits should be applicable to individual color channels. In addition, dialogs should offer real-time previews, and users should be able to reedit any changes applied to a picture.

The ability to create and reedit precise masks easily is vital to **compositing**, the process of selecting elements from two or more images and combining them to create a new image. A robust layers or objects palette is crucial. Other key features include easy and effective masking and selection tools.

In the **painting** category, we look for tools that are easy to use and that unleash users' creativity. The tools should include a rich and varied default set of brushes, and the program should let users create and save new brushes. Color palettes should be easily accessible, so that users can change colors without interrupting the painting process. The ability to paint on an empty layer or object is critical, because it lets users paint without merging the strokes into underlying pixels.

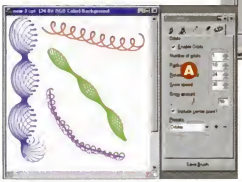
To create **Web graphics**, the program must convert 24-bit (or 32-bit) images into 8-bit color pictures appropriate for the Web. During downsampling, the program should provide a flexible palette, a preview window, and an estimate of the time required to download. Some programs include batch-processing tools for creating graphics with indexed colors. Users should be able to define URL hot spots from within the program and generate server- and client-side image maps. Our rating also reflects the quality of the graphics produced when viewed within a browser.


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Corel Photo-Paint 8

$330 street (upgrade from any version of Photo-Paint or from Adobe Photoshop or MetaCreations' Painter, $100). Corel Corp., Ottawa; 800-772-6735, 613-728-8200; www.corel.com; 502 at www.pcmag.com/infolink.

● Last year's Editors' Choice, Corel Photo-Paint, is back in a new version that is no bigger (it actually shrank) but is certainly better. In addition to a streamlined interface, Corel has grouped related tools together and added dynamic brushes and integrated color management. Photo-Paint's compositing tools are not as good as those of Adobe Photoshop or Wright Design 2.0, but the program provides the broadest range of tools, making it an excellent value—especially if you purchase it as part of the $500 (street) CorelDraw 8 suite.



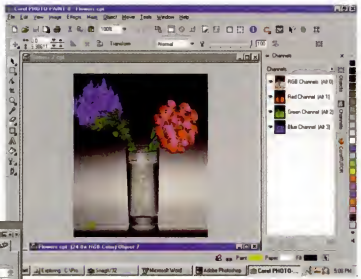


Photo-Paint's workspace includes tabbed palettes called Dockers and color swatches on the right edge of the screen. (A) The Orbits dialog multitipped brushstrokes. (B) Index color options.

Although it retains the same toolbox, pull-down menus, tool property bar, and status bar, Photo-Paint's interface has been enhanced. Some of the roll-up palettes are now *Dockers*—tabbed palettes attached by default to the right side of the workspace.

One of the strongest features of the previous version was the meshing of both layerlike and objectlike behaviors. In Version 8, Corel has made the merger even smoother by combining layer and object tools into the Objects docker. This means that collaging in Photo-Paint requires fewer mouse clicks than before.

Photo-Paint's Lens Effects are objects that contain commands rather than pixels. For example, a Lens Effect can contain a gamma curve or a color correction, affecting either all the objects below it or only the object directly below the Lens. Lens Effects remain fully reeditable.

Masking is lean and powerful. The object transparency tool applies a gradient mask directly onto the object, so you can view the effect immediately, without having to activate an alpha channel. Unfortunately, gradient masks are not reeditable (unless you create them as clipping masks). You can also paint levels of transparency directly on to an image.

The new Magic Scissors Mask tool is designed to locate the edges of objects quickly. But on our tests, it failed to produce an accurate mask. Adobe Photoshop's new Magnetic Lasso tool seems to do a better job at identifying edges.

Photo-Paint's Undo list is a basic compilation of all the edits that can be removed or redone. While you work, you can take periodic snapshots of your image, called Checkpoints, in case you need to restore a prior version. And, unlike in Photoshop's History palette, the Undo list may be saved in its own file.

Although Photo-Paint is accomplished in nearly all areas, its painting features are its strongest suit. Photo-Paint's rich collection of dynamic, detailed, and highly customizable brushes and textures make painting on the PC the fun process it should be. To further expand your toolset, you can use any image as a brush texture.

The new Orbits painting mode consists of multiple nibs that, during painting, dynamically interact with one another according to a pattern you assign, creating lively strokes. Orbits also work with Photo-Paint's Image Sprayer, so you can create sets of your image that dance about as you spray them onto your canvas. Brush Symmetry creates a mirror image of your strokes while you paint. Color controls are immediately accessible in swatches along the screen's right edge and in a Roll-Up of the full spectrum. You can create and save custom color palettes in the Palette Editor.

Photo-Paint's Gradient fill tool is the easiest and most versatile we have seen. To apply a gradient, just click and drag in your picture to position the initial mid- and end-points. You can add points and colors wherever you want with a click of the mouse and change any node's transparency level using a slider control.

Once a separate utility, color management is now integrated and is ICC-compliant. The results, though not perfect, are far better than those we saw in Version 7.0. Printouts look very similar to screen images, and moving a picture among color models (such as CMYK, RGB, and others) does not degrade tone or hue on screen.



Photo-Paint's Web graphics tools are well-rounded. To create a hot spot, you select an object and enter the target URL in the Object Properties dialog box. The hot spot area can be a rectangle, a circle, a bounding oval, or the shape of the object. Indexed (8-bit) color options are extensive, and there's even a batch conversion utility that creates an average palette for a group of images.

Photo-Paint's compositing tools are improving. Its brushes, textures, and color options are a delight to use, and the Web graphics tools are extensive, making it the one-stop shop for all types of image-editing tasks.—*SWG and DG*

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■ YES ▥ NO

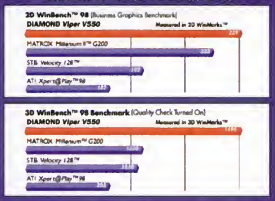
	Adobe Photoshop 5.0	Corel Photo-Paint 8	Painter 5	Picture Publisher 8	QFX 6.25	Wright Design 2.0
Price	$650 street	$330 street	$300 street	$150 street	$399 online[1]	$699 direct
Direct pixel editor/On-demand pixel editing with rendering	■ ■	■ ■	■ ■	■ ■	■ ■	■ ■
One-click multiple undo	■	■	■	■	■	■
Painting and Drawing Tools						
Airbrush/Charcoal/Crayon	■ ■ ■	■ ■ ■	■ ■ ■	■ ■ ■	■ ■ ■	■ ■ ■
Felt-tip pens/Oil/Watercolor	■ ■ ■	■ ■ ■	■ ■ ■	■ ■ ■	■ ■ ■	■ ■ ■
Pen and ink/Pencils/Calligraphic line	■ ■ ■	■ ■ ■	■ ■ ■	■ ■ ■	■ ■ ■	■ ■ ■
Clone/Revert clone/Artistic clone	■ ■ ■	■ ■ ■	■ ■ ■	■ ■ ■	■ ■ ■	■ ■ ■
User can create/edit/save brush	■ ■ ■	■ ■ ■	■ ■ ■	■ ■ ■	■ ■ ■	■ ■ ■
Pressure sensitivity	■	■	■	■	■	■
User can specify transparency	■	■	■	■	■	■
Brushes can react to paper texture	■	■	■	■	■	■
Brush strokes on empty layer or object	■	■	■	■	■	■
Brush strokes are reeditable	■	■	■	■	■	■
Arcs/Circles/Polygons	■ ■ ■	■ ■ ■	■ ■ ■	■ ■ ■	■ ■ ■	■ ■ ■
Freehand/Bezier (spline)	■ ■	■ ■	■ ■	■ ■	■ ■	■ ■
Image spray/Paint with picture	■ ■	■ ■	■ ■	■ ■	■ ■	■ ■
Linear and Radial Gradient Fills						
User-definable shape/angle/center	■ ■ ■	■ ■ ■	■ ■ ■	■ ■ ■	■ ■ ■	■ ■ ■
Spectrum gradients/multiple color gradients/node transparencies	■ ■ ■	■ ■ ■	■ ■ ■	■ ■ ■	■ ■ ■	■ ■ ■
Selection and Collaging						
User can save masks as alpha channels/independent files	■ ■	■ ■	■ ■	■ ■	■ ■	■ ■
Image can be defined as alpha channel	■	■	■	■	■	■
Masks are reeditable/rotatable	■ ■	■ ■	■ ■	■ ■	■ ■	■ ■
Layers/Layer palette/Layer masks	■ ■ ■	■ ■ ■	■ ■ ■	■ ■ ■	■[2] ■[2]	■ ■ ■
Objects/Object palette/Object masks	■ ■ ■	■ ■ ■	■ ■ ■	■ ■ ■	■[2] ■[2]	■ ■ ■
Magnetic selection tools	■	■	■	■	■	■
Path to mask/Clipping paths	■ ■	■ ■	■ ■	■ ■	■ ■	■ ■
Image Processing						
Equalizing/Anti-aliasing	■ ■	■ ■	■ ■	■ ■	■ ■	■ ■
User can edit histogram/gamma curve/by channel	■ ■ ■	■ ■ ■	■ ■ ■	■ ■ ■	■ ■ ■	■ ■ ■
Number of included filters and effects	114	More than 70	36	127	21	More than 100
User-definable automation plug-ins or production macros	■	■	■	■	■[3]	■
Lens Objects, Adjustment Layers, or equivalent	■	■	■	■	■	■
Multiple undo and redo list	■	■	■	■	■	N/A
Can be saved with image/saved as file	■ ■	■ ■	■ ■	■ ■	■ ■	N/A
Snapshot/Branching (nonlinear multiple undo)	■ ■	■ ■	■ ■	■ ■	■ ■	N/A
Memory purge	■	■	■	■	■	■
Web Graphics						
Objects or selections can be defined as URL hot spots	■	■	■	■	■	■
Client-side/Server-side image maps	■ ■	■ ■	■ ■	■ ■	■ ■	■ ■
Palette indexing/Editable color tables	■ ■	■ ■	■ ■	■ ■	■ ■	■ ■
Exports animated GIF/transparent GIF	■ ■	■ ■	■ ■	■ ■	■ ■	■ ■
Text Handling						
Vector-based text	■	■	■	■	■	■
Text is reeditable	■	■	■	■	■	■
Kerning/Leading/Tracking	■ ■ ■	■ ■ ■	■ ■ ■	■ ■ ■	■ ■ ■	■ ■ ■
Linked columns/Paragraph formatting/User can define styles	■ ■ ■	■ ■ ■	■ ■ ■	■ ■ ■	■ ■ ■	■ ■ ■
Fit text to path/Rotate/Distort	■ ■ ■	■ ■ ■	■ ■ ■	■ ■ ■	■ ■ ■	■ ■ ■
Prepress						
User can specify CMYK channels independently	■	■	■	■	■	■
Spot color	■	■	■	■	■	■
User can define/save ink	■ ■	■ ■	■ ■	■ ■	■ ■	■ ■
Supports ICC color management	■	■	■	■	■	■

N/A: Not applicable—In Wright Design, you can save all actions on separate layers and change them at any time. (1) $499 by phone. (2) In Draw mode only. (3) QFX 6.25 does have batch mode, however.



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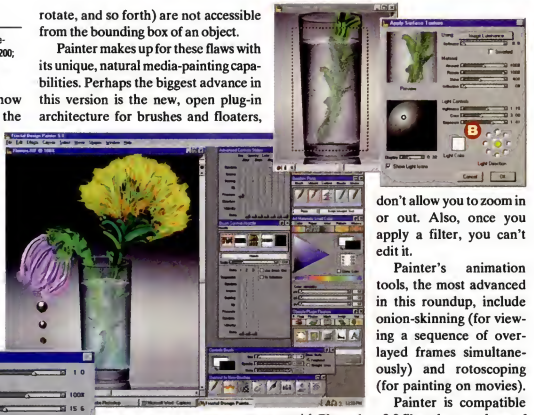
Painter 5

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● Created by Fractal Design and now owned by MetaCreations, Painter is the product that broke the mold for professional image editing. Its interface flies in the face of tradition, and its approach to image-editing tasks is often unorthodox. Nevertheless, Painter has prospered on the strength of its unique Natural Media brushes and textures. Painter is not designed to replace mainstream image-editing packages such as Adobe Photoshop; rather, it makes a great complement to them.

With its proliferation of palettes and tools scattered in different locations, Painter is not an easy program to master. But the documentation is superb, and the tutorials (contained in a 97-page booklet) are among the best in the business.





Painter's workspace contains a disconcertingly large array of palettes and toolbars, but the documentation is superb. (A) Liquid Metal Plug-in. (B) Painter offers unique filters.

Painter includes more than 100 new brushes that, when combined with the dizzying array of textures and surface controls, add up to a tool library that you could spend days experimenting with and never repeat the same task. The downside is that it can be tough to find exactly the tool you need.

Painter's masks now behave according to the industry standards. However, layers (MetaCreations calls them *floaters*) and masks are organized in two nested palettes; hence you must move between them to work on your image. Perfecting masks and selections remains difficult. For example, the gradient mask can't produce crisp whites or blacks.

The other major drawback to Painter is that it is lacking in some key image-editing areas. For example, compositing is not smooth; tonal and exposure controls are minimal; and the orientation tools (scale, rotate, and so forth) are not accessible from the bounding box of an object.

Painter makes up for these flaws with its unique, natural media-painting capabilities. Perhaps the biggest advance in this version is the new, open plug-in architecture for brushes and floaters, which add special effects to images.

The plug-in floaters are dynamic special effects that act on selected objects—similar to Lens Objects in Corel PhotoPaint. The creative control they offer over applying texture and dimensionality is remarkable, but they have some weaknesses: Only one plug-in per object remains editable because, when you apply a new one, the earlier one is merged into the pixels that make up the object or floater beneath. In addition, you can't cancel most plug-in floaters from within the dialog box (you have to apply it and then undo it).

The new plug-in brushes include glowing, fiery brushes, useful photographic tools, more variable cloners (brushes that distort the underlying pixels), and others. An important development is the plug-in brushes that let you paint on a new layer.

Unlike most image-editing packages, Painter includes filters that alter lighting and textures rather than creating special effects. But they are not sleek; many lack previews; and those that do have previews don't allow you to zoom in or out. Also, once you apply a filter, you can't edit it.

Painter's animation tools, the most advanced in this roundup, include onion-skinning (for viewing a sequence of overlayed frames simultaneously) and rotoscoping (for painting on movies).

Painter is compatible with Photoshop 3.0 filters but not those of later versions. Painter also now supports Photoshop's PSD file format, keeping layers, channels, and paths intact. But it is strictly an RGB editor: Painter does not support CMYK files or color model conversions. Painter 5 is ICC-compatible; it has a simple dialog for selecting profiles. But it lacks a gamma dialog for profiling monitors and ink setups for prepress.

On our print tests, Painter produced bright, crisp colors with a decent dynamic range. Type was nicely formed, with no obvious jaggies. However, Painter does not produce true blacks (its black is more of a midnight blue), and the color fidelity was not as good as that of the other programs we tested.

Painter's Web tools are uneven. The included Bevel World plug-in makes nice buttons for Web pages, and seamless tiled backgrounds are easy to do. You can assign URLs to objects in the Object properties dialog box, and the hot spot can be a rectangle or oval (or polygon, for vector shapes only). Other Web features such as indexed colors and image maps are less developed.

For photo editing, collaging, and Web graphics, get another program. But for applying color, texture, and light to your digital images in creative ways, Painter 5 is unsurpassed.—*SWG and DG*



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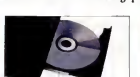
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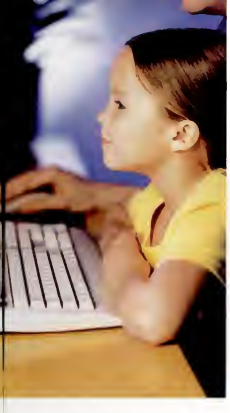
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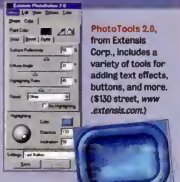
add-on infinitum

When Adobe introduced its open plug-in architecture in Photoshop, it spawned a thriving market of third-party add-ons that perform specific tasks. This market has grown so large that most competing image editors also support the Photoshop plug-in standard. And while most of these plug-ins are for use in image editors, you'll find plug-ins for illustration programs as well. One word of warning: With Photoshop 5.0, Adobe changed the "plugins" directory to "Plug-Ins"; hence you'll have to locate the proper directory manually to complete the installation successfully.—*Matthew Graven*

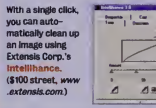
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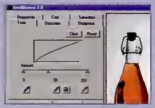
Extensis Corp.'s **Mask Pro** is one of the best masking tools on the market. Using an eyedropper, you pick color ranges that you want to keep or drop. ($300 street, *www.extensis.com.*)



PhotoTools 2.0, from Extensis Corp., includes a variety of tools for adding text effects, buttons, and more. ($130 street, *www.extensis.com.*)

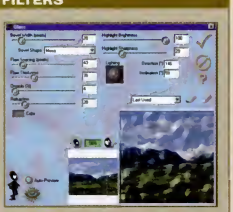


With a single click, you can automatically clean up an image using Extensis Corp.'s **Intellihance.** ($100 street, *www.extensis.com.*)



PhotoTools adds palettes to your workspace so that you can access Extensis Corp. and Photoshop filters and tools quickly and easily.

FILTERS



With a library of distortion effects, Alien Skin Software's **Eye Candy** lets you create stunning images. ($130 street, *www.alienskin.com.*)

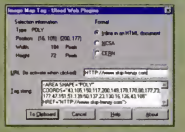


The Lens f/x filters in **Kai's Power Tools 3,** from MetaCreations Corp., include image enhancement tools and effects plus a unique preview lens. ($150 street, *www.metacreations.com.*)

WEB TOOLS



To make graphics Web-ready, Auto F/X Corp.'s **WebVise Totality** offers a sleek interface with slide controls for optimizing graphics and adding transparency. In separate modules, you can optimize GIFs and JPEGs, adjust dithering, and create watermarks. ($130 street, *www.autofx.com.*)



Photoshop may be lacking in Web features, but Ulead Systems' **Ulead WebRazor** evens the score. WebRazor can optimize Web graphics and create buttons, but its ability to produce highly detailed image Map tags is what sets it apart. ($100 street, *www.ulead.com.*)

EFFECTS



The digital equivalent of a kaleidoscope, Ulead Systems' **Ulead FantasyWarp.PlugIn** has great warp and mirror effects. ($30 street, *www.ulead.com.*)

3-D TOOLS



Vertigo Technology's **Vertigo 3D PopArt** for Adobe Illustrator allows you to convert objects into 3-D objects. We found this especially useful for adding consistent 3-D depth to text. ($40 street, *www.vertigo3d.com.*)



Vertigo Technology's **Vertigo 3D HotText** allows you to create true 3-D text in your image editor. You can use any of your installed fonts, create your own paths, and control the lighting angle. ($150 street, *www.vertigo3d.com.*)



Ulead ArtTexture.PlugIn allows you to create psychedelic patterns and animations. ($30 street, *www.ulead.com.*)

Picture Publisher 8

$150 street. Micrografx Inc., Richardson, TX; 800-733-3729, 972-234-1769; www.micrografx.com; 504 at www.pcmag.com/infolink.

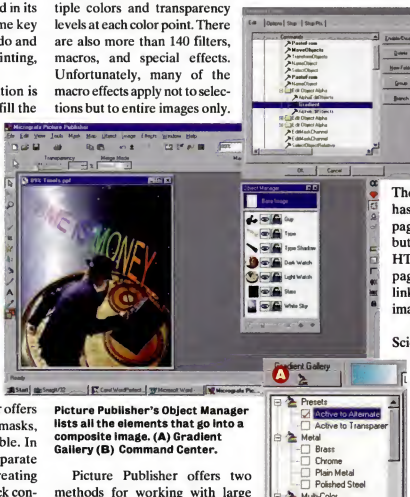
● Micrografx's Picture Publisher is the most affordable and one of the easiest programs to use in this category. Version 8 adds more macros and wizards to further simplify image editing. And Picture Publisher 8's Web graphics tools are without question the most sophisticated in its class. But the program's lack of some key features, such as easy multiple undo and separate layers or objects for painting, limits Picture Publisher's appeal.

Picture Publisher's documentation is scant, and the online help fails to fill the gap, but the program provides may other features that make it easy to use. Knowledge wizards help you get up to speed on specific tasks. Picture Publisher's interface is crammed with information that helps guide the user and provides control over tools. Besides the traditional toolbox, Picture Publisher has a variety of palettes, including a ribbon bar of tool options and a status bar.

Picture Publisher provides extensive control over composite images. Using objects rather than layers, all pasted selections and new text function independently of each other. The Objects Manager offers single button access to object masks, which remain distinct and reeditable. In addition, masks can be saved as separate files and used in other images. Creating drop shadows is another mouse-click control, but this works only if the object does not flow over the picture margins. Unfortunately, the Objects palette offers nothing like Adobe Photoshop's Adjustment Layers for applying effects on a separate layer. Nor does it give controls for the objects it contains; you must open the View menu to access object properties.

Because Picture Publisher has no provision for creating empty objects on which to paint, brushstrokes must be placed over existing pixels. Furthermore, there is still only one level of undo. Micrografx claims that its Command Center takes the place of multiple undos, but this feature can be cumbersome to use. For example, to undo two brushstrokes, Command Center must rebuild the entire image from the first edit onward. Like Adobe Photoshop's History palette, Command Center supports nonlinear editing. But Command Center also lets you save the edit list with the image file.

Picture Publisher offers an impressive variety of brushes and textures. You can save custom settings to be used with the image spray tool. Gradients now offer multiple colors and transparency levels at each color point. There are also more than 140 filters, macros, and special effects. Unfortunately, many of the macro effects apply not to selections but to entire images only.



Picture Publisher's Object Manager lists all the elements that go into a composite image. (A) Gradient Gallery (B) Command Center.

Picture Publisher offers two methods for working with large files. FastBits divides high-resolution images into a grid; you can open segments of the grid and perform edits, which are then saved back to the full image. Or you can work on an image's low-resolution version, save the version in Micrografx's PPF file format, and then link it to the original file.

Web tools are Picture Publisher 8's strongest suit. The Web Output wizard is an easy step-by-step guide for saving GIF or JPEG files and previewing the results in your Web browser. The JPEG save dialog, which allows before and after previews and download estimates, is one of the best we've seen:. The Web Output wizard and the Save As dialog, however, lack the extensive control over transparency found in the manual Export/GIF dialog box. As in Corel Photo-Paint 8, you can assign a URL to an object in its Properties dialog box. In addition to custom-color palette options, the program has a wizard for creating average palettes and performing batch conversions.

Picture Publisher has increased the number of wizards that automate tasks. The Web Styles wizard has templates for Web pages, including graphical buttons. A contact-sheet HTML generator creates pages of thumbnails that link to the full-resolution images.

Using Kodak's Digital Science Color Management, Picture Publisher produced an astonishing level of color fidelity among color models (RGB, CMYK, and Lab) and between the screen and the printed image on our tests. Unfortunately, the text exhibited jaggies, and the general printed image quality was not as impressive. You can open multiple images—each in its own color space on your screen, however. Note that the Color Management module can be accessed only through the Custom install option.

When preparing images for the Web, Picture Publisher's ease and power are tough to beat. But design professionals who need to create artwork for multiple media types should look to a more comprehensive program such as Photoshop or Photo-Paint.—*SWG and DG*



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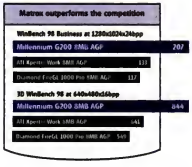
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QFX 6.25

$399 online, plus $50 for manual (upgrade from Version 5.x, $249; upgrade from earlier versions, $349). Ron Scott Inc.; Houston; 713-529-5868; www.qfx.com; 505 at www.pcmag.com/infolink.

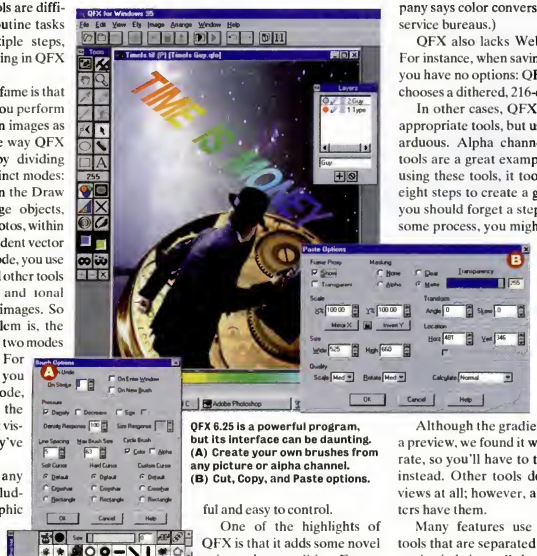
● The brainchild of photographer Ron Scott, QFX was designed as a production tool for editing high-resolution images. Targeted at professionals, QFX demands a level of graphics proficiency but in return offers some powerful tools. Unfortunately, QFX 6.25 has not kept pace with the rest of the industry. Some key features, such as Web graphics tools, are missing. Other tools are difficult to use, and routine tasks can involve multiple steps, making image editing in QFX hard work.

QFX's claim to fame is that the software lets you perform real-time editing in images as large as 4GB. One way QFX achieves this is by dividing tasks into two distinct modes: Draw and Paint. In the Draw mode, you arrange objects, such as text and photos, within resolution-independent vector shapes. In Paint mode, you use brushes, filters, and other tools to edit the pixel and tonal details of bitmap images. So far so good. Problem is, the integration of these two modes is not seamless. For instance, when you enter the Paint mode, objects placed in the Draw mode are not visible unless they've been rendered.

In Draw mode, any closed object (including a photographic image) automatically fills with the last-used color, gradient, or picture. Or the object can be empty. Toolbox options ease the task of creating soft, blurry vignette edges or of changing the transparency of an object.

When you select Save in Draw mode, QFX saves the group of objects, not the file. When you reopen the picture, you must first open the background (if the image is a bitmap) in the Paint mode, then switch to the Draw mode and open the relevant group of objects. Rendering the objects merges them into the background and converts them to bitmap format for editing in the Paint mode and for printing.

In Paint mode, QFX's pressure-sensitive brushes are resolution-independent, 32-bit images, consisting of both shape and alpha channels. The program includes only a handful of preset brushes, but you can easily create your own from any picture or from the alpha channel. Color and gradient tools are also powerful and easy to control.



QFX 6.25 is a powerful program, but its interface can be daunting. (A) Create your own brushes from any picture or alpha channel. (B) Cut, Copy, and Paste options.

One of the highlights of QFX is that it adds some novel twists to image editing. Even a simple set of commands such as Copy and Paste becomes a powerful tool, giving you control over the pasted object or image and its mask, transparency, size, angle, skew, location, and blend. Another unusual feature is Window Linking, which connects two images and/or their alpha channels to generate interesting painting or filter effects.

Despite these noteworthy tools, QFX can't compete with the leaders in professional image editing because it is missing some key features. One major drawback is that its Paint mode does not support multiple layers.

Like Wright Design, QFX was built on Windows NT, which does not yet support ICC profiles. So you need to do a lot of eyeballing and guesswork to get faithful color output on-screen and from the printer. In addition, QFX does not include a tool for converting between RGB and CMYK color spaces. (The company says color conversion is best left to service bureaus.)

QFX also lacks Web graphics tools. For instance, when saving to GIF format, you have no options: QFX automatically chooses a dithered, 216-color palette.

In other cases, QFX provides all the appropriate tools, but using them can be arduous. Alpha channel (or masking) tools are a great example. On our tests, using these tools, it took no fewer than eight steps to create a gradient mask. If you should forget a step in this cumbersome process, you might not know until the end when you wind up with no mask. On a more positive note, QFX lets you save masks as independent files that can be used on any object or picture.

Although the gradient mask tool has a preview, we found it was not very accurate, so you'll have to trust the settings instead. Other tools do not have previews at all; however, all effects and filters have them.

Many features use commands and tools that are separated from each other or buried in pull-down menus. For instance, when using the transformation tools, rather than directly manipulating the object's bounding box by hand, you must use commands in the Edit menu—and again with no preview.

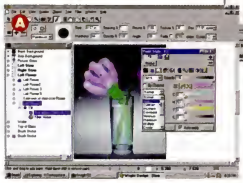
QFX is currently a half-finished masterpiece. In some places, the product shows flashes of genius, but in other areas it remains a blank canvas.—*SWG and DG*

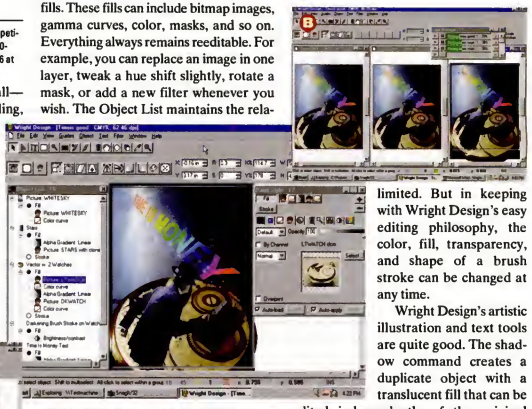
Wright Design 2.0

$699 direct (upgrade from previous versions and competitive products, $349). Wright America Inc., Toronto; 800-259-5580, 416-360-5154; www.wrightamerica.com; 506 at www.pcmag.com/infolink.

● Wright Design 2.0 tries to do it all—image editing, illustration, text handling, and page layout—within one object-based interface. In Wright Design, Wright America has achieved a level of integration and intelligence that makes editing and compositing much easier and faster than in other programs—once you get a handle on the program's nonstandard interface. Unfortunately, some important features, such as ICC profiles support and Web graphics tools, are lacking.

The biggest drawback is that





In Wright Design, each element of the image is defined as a separate layer in the Paint Styles palette. (A) Brushstrokes are objects that can be filled with anything. (B) Multitasking in Wright Design.

Wright Design takes time to learn because it doesn't work like other desktop graphics programs. The PDF-based tutorials introduce the basics, but they are inconvenient. The documentation is thorough, however. And once you've invested the time to learn the program, you'll be rewarded with Wright Design's powerful features.

An on-demand pixel editor, Wright Design offers real-time editing even in high-resolution images. Although photos and other bitmap images must be converted to Wright's proprietary DCM file format, batch conversions are quick. The layout, vector objects, text, and other edits (including pointers to the original bitmap files) are saved in Wright's WDD format. Rendering may be time-consuming, depending on the image's complexity and the destination file format, but you can off-load it to a network server or another client. And since Wright Design was built on Windows NT, it provides true multitasking and multithreading.

In a layout, objects can contain layers of fills. These fills can include bitmap images, gamma curves, color, masks, and so on. Everything always remains reeditable. For example, you can replace an image in one layer, tweak a hue shift slightly, rotate a mask, or add a new filter whenever you wish. The Object List maintains the relationships between these layers.

The tabbed Paint Styles palette contains all the fill and stroke types that may be applied to an object. For instance, in our test composition, one elliptical object contained two bitmaps, a gamma curve for each, and a gradient mask—each defined as a separate layer. What's more, when we edited a Bezier curve that defined the object shape, we could refine a silhouette mask that cut the two bitmaps from their original images. In fact, since no bitmap image is actually changed during editing, you can always restore any portion or paint back sections using the negative masking brush.

You can save any custom Paint Style, such as a color that is applied at a specified transparency or with a certain blend mode. In addition, any object (or individual fill) can be saved as a separate picture, enabling it to be used as an alpha channel. The transformation tools are very accessible and may be used interactively on objects or by inputting values.

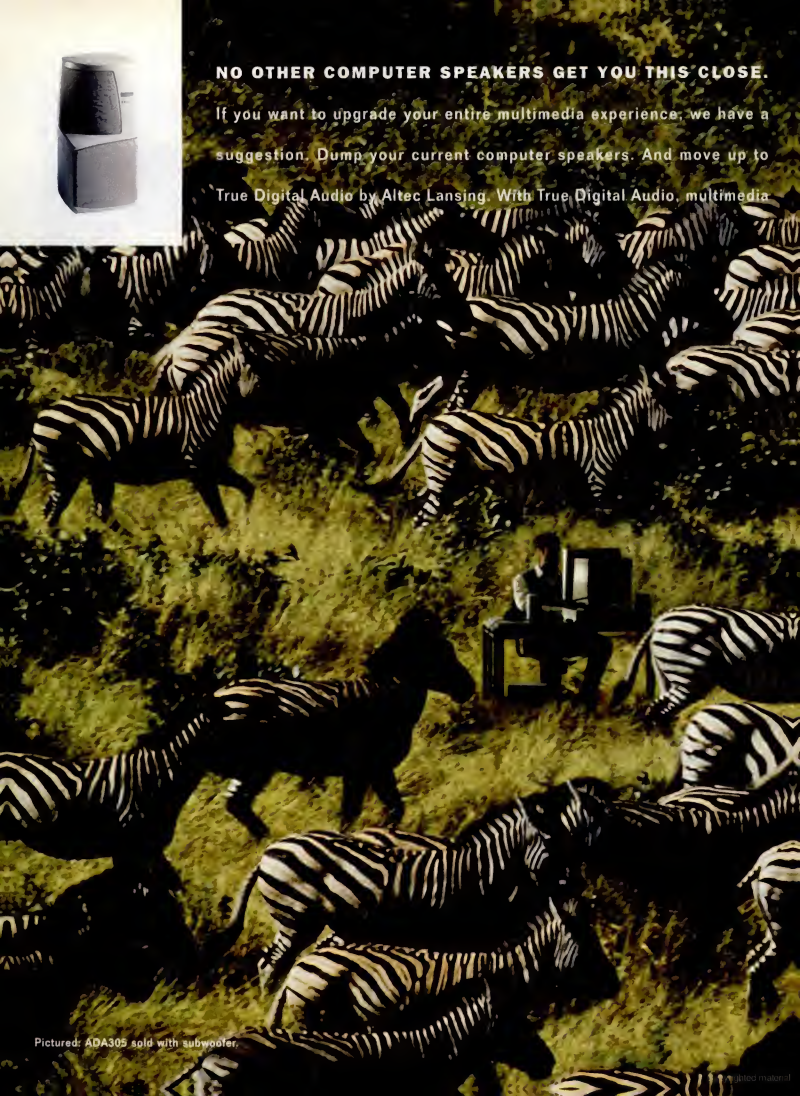
Although image editing and compositing are first-rate, painting with Wright Design is disappointing. The brushes are limited. But in keeping with Wright Design's easy editing philosophy, the color, fill, transparency, and shape of a brush stroke can be changed at any time.

Wright Design's artistic illustration and text tools are quite good. The shadow command creates a duplicate object with a translucent fill that can be edited independently of the original object. But when you move or alter the original, the linked shadow is changed appropriately.

Text handling is versatile, with paragraphs, columns, drop caps, text linking among objects, kerning, tracking, and various path shaping. Any open or closed vector shape can be made into a text container. Text envelopes can be edited using the Bezier tool. Rather than importing text directly, however, Wright Design uses the Windows Clipboard.

Since the program was built on Windows NT 4.0, which does not support ICC profiles, Wright Design relies on a gamma dialog box for calibrating your monitor and a sample printed page (which is not included) to correct CMYK output. Once you become adept at fine-tuning the color management, the printouts are smooth and crisp, with decent color matching the screen. Vectors and bitmaps can peacefully coexist in the same output file.

Wright Design 2.0 is a remarkable production tool that successfully combines top-notch compositing, superb text handling, and excellent illustration features. Despite its nontraditional interface and missing features, Wright Design is an innovative program that will influence the graphics industry.—*SWG and DG*



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illustration

Adobe Illustrator 8.0 (beta)

$380 street (upgrade, $130; competitive upgrades, $200). Adobe Systems Inc., San Jose, CA; 800-649-3875, 408-536-6000; www.adobe.com; 501 at www.pcmag.com/infolink.

● In a reference to its tight integration with Adobe's page-description language, Adobe Illustrator has been described as "a front end to PostScript." True to this form, Version 8.0 of Illustrator introduces several spectacular new drawing tools driven by Adobe PostScript 3. We tested a beta version of Illustrator 8.0; the final version should be available shortly after you read this. Based on our preview, we feel that Illustrator 8.0 will be a significant upgrade, with new tools for Illustrator veterans and usability enhancements that make the program more accessible to new users.

Chief among Illustrator 8.0's new features is the Gradient Mesh tool, which places an editable, wire-frame grid inside an object outline. Because you can assign a different color to each vertex, you can create a multidirectional blend of different colors that can model an object's surface or simulate watercolor washes.

Other PostScript 3–related features include Illustrator's new multiple-shape blends and Art Brushes. An Illustrator blend can now include more than two objects, and both the shapes that form the blend and the path along which the blend is arranged can be reshaped using standard Bezier editing tools. Art Brushes—similar to tools introduced in MetaCreations' Expression (which has not been upgraded since our last story)—allow you to "paint" with vector graphics. Options in the Brushes palette let you determine whether a brush stroke will create a single object, scatter multiple copies of the object along a path, or produce a regular pattern.



Illustrator's new Gradient Mesh allows you to apply colors to each vertex in a wire-frame. (A) The Scatter art brush lets you paint with a vector image. (B) Attributes palette.

These admittedly complex tools are balanced by new functions that actually make Illustrator more accessible to non-professional artists. A standard selection mode (with handles that let you resize objects directly) eliminates that initial period of frustration for new users unfamiliar with Illustrator's Direct Select and Group Select tools. Likewise, the Free Transform tool provides a single gizmo box to size, skew, rotate, and distort outlines. More important, Illustrator 8.0 supplements traditional Bezier curve tools with easy-to-use drawing tools. For example, after you've drawn a freehand line with the Pencil, you can use the same tool to reshape the curve by drawing segments of the line over again. And the new Smooth tool lets you remove unnecessary nodes and polish curves with a simple dragging motion.

We were impressed with Illustrator's elegant solutions for common drawing tasks. Though you still can't save defined styles, you can use the improved Eye-

suitability to task: illustration









POWER	Adobe Illustrator 8.0	Canvas 5.0.3	CorelDraw 8	FreeHand 8
Artistic illustration	Excellent	Fair	Excellent	Excellent
Technical illustration	Fair	Excellent	Good	N/A
Print output	Excellent	Good	Good	Excellent
Web output	Good	Good	Excellent	Good
EASE				
Artistic illustration	Excellent	Fair	Good	Excellent
Technical illustration	Good	Good	Excellent	N/A
Print output	Good	Good	Excellent	Excellent
Web output	Excellent	Good	Excellent	Excellent

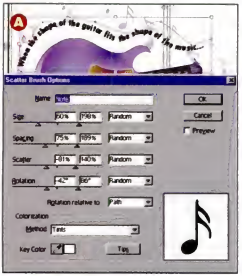
N/A—Not applicable. The product does not have this feature.

In the first category, **artistic illustration**, we look for flexible and robust handling of page layout, including support for multiple pages and folded paper and the handling of margins and gutters. We also take into account the program's ability to create objects easily and to apply special effects such as intersections, gradients, patterns, textures, and perspective. During editing, color pickup and an ability to model the selection and save color palettes are also important, as is the ability to utilize the objects in layers.

To receive good marks in the **technical illustration** category, an illustration package should let the user draw lines to exact dimensions, snap to grid lines, and enter specific values in a dialog box. Also, the precision tools should allow for angle and line bisection, should measure or constrain the angle of a line, and should be able to snap to a specific point on another object (such as a tangent point on an ellipse or circle). A big plus is automatic dimensioning, which lets the user draw to scale or change the size of an object by altering the value of the dimension line. A robust application will integrate well with CAD packages by providing support for both layers and AutoCAD's DXF (Document Exchange Format) files.

To deliver optimal **print output**, the program should print gray-scale drawings with crisp lines and solid blacks and whites. It should also render hatch patterns with smooth, fine lines. The program should support a range of export file formats, including EPS, GIF, JPEG, and WMF files. On color-printing tasks, we look for reliable support for maintaining CMYK values, easy and effective calibration routines, printer-profile settings, and print-preview tools to assist the user in obtaining accurate color prints. We also examine how well the color output matches the screen image and whether it suffers from moiré patterns or banding. Last, we like programs that have easy-to-use color-separation controls with reporting mechanisms.

In our final category, **Web output**, we look for the ability to export to GIF, JPEG, and HTML. We also test each program's animation features, JPEG compression, dithering controls, and transparency support. Illustration programs should let users easily create common Web page elements such as buttons and URL hot spots. Some programs also provide output alternatives based on Java or Adobe's PDF for faithful rendering of complex illustrations and layouts that can be viewed in a browser.





dropper to copy attributes from one object to another. You can also automatically update related tints in a document. And, no matter whether you've filled a shape with text, changed the orientation from horizontal to vertical, or flowed text along a path, you have access to Illustrator's robust typographics controls. Best of all, the new Actions palette lets you create macros for frequently used commands and/or drawing sequences; an included Action generates buttons for Web pages.

Despite these many enhancements, there are still a number of areas where Illustrator is either idiosyncratic or falls short. For example, Illustrator easily generates GIF, JPEG, and URL image maps for the Web, but it does not offer HTML, vector, or Web animation formats. The rudimentary autotracing is suitable only for simple outlines, and the program has no 3-D extrusion tools (although you can create 3-D effects with Actions and Blends). For these functions, you'll need third-party plug-ins or other Adobe products.

Similarly, as we discovered on the technical illustration portion of our script, Adobe relies on plug-ins to extend Illus-

SUMMARY OF FEATURES

Illustration

PC MAGAZINE EDITORS' CHOICE

■ YES, ■ NO	Adobe Illustrator 8.0	Canvas 5.0.3	CorelDraw 8	FreeHand 8
Price	$380 street	$400 street	$500 street	$400 street
Macro recorder/OLE server/OLE client	■ ■ ■	■ ■ ■	■ ■ ■	■ ■ ■
Illustration Management				
User can lock/hide objects	■ ■	■ ■	■ ■	■ ■
User can lock/hide layers	■ ■	■ ■	■ ■	■ ■
Includes master pages/templates	■ ■	■ ■	■ ■	■ ■
User can move objects between layers	■	■	■	■
Object manager	■	■	■	■
Object properties/Object data	■ ■	■ ■	■ ■	■ ■
Object styles/Text styles/Linked colors	■ ■ ■	■ ■ ■	■ ■ ■	■ ■ ■
Color-mixing models	CMYK, gray-scale, HSB, RGB	CMYK, HSL, RGB	CMYK, gray-scale, HSL, HSB, RGB	CMYK, gray-scale, HSL, RGB
Major color-matching models	DIC, Focoltone, Pantone, Toyo, Trumatch, Web-safe color libraries	Pantone, Toyo, Trumatch	DIC, Focoltone, Hexachrome, Lab, Pantone, Process, SpectraMaster, Spot, Toyo, Trumatch, Web-safe color libraries	DIC, Focoltone, Munsell, Pantone, Toyo, Trumatch, Web-safe color libraries
Illustration Tools				
Beveled, rounded, and mitered corner joins	■	■	■	■
Bitmap/fractal/vector pattern fills	■ ■ ■	■ ■ ■	■ ■ ■	■ ■ ■
Gradient/transparent[1]/PostScript fills	■ ■ ■	■ ■ ■	■ ■ ■	■ ■ ■
Calligraphic/parallel/dimension lines	■ ■ ■	■ ■ ■	■ ■ ■	■ ■ ■
Intelligent connecting lines	■	■	■	■
Gradient/natural-media strokes	■ ■	■ ■	■ ■	■ ■
Align/distribute objects	■ ■	■ ■	■ ■	■ ■
Snap objects to guidelines/grid	■ ■	■ ■	■ ■	■ ■
Snap objects to objects/nodes	■ ■	■ ■	■ ■	■ ■
Combine/break/slice objects	■ ■ ■	■ ■ ■	■ ■ ■	■ ■ ■
Blend/envelope objects	■ ■	■ ■	■ ■	■ ■
Boolean/weld objects	■ ■	■ ■	■ ■	■ ■
Bevel/Extrude/Perspective	■ ■	■ ■	■ ■ ■	■ ■
Clip bitmap to object/Clip object to object	■ ■	■ ■	■ ■	■ ■
Edit/manipulate bitmapped images	■ ■	■ ■	■ ■	■ ■
Apply 2-D effects/3-D effects to bitmaps	■ ■	■ ■	■ ■	■ ■
Apply plug-ins to bitmaps	■	■	■	■
Text Handling				
Tracking/kerning/leading	■ ■ ■	■ ■ ■	■ ■ ■	■ ■ ■
Flow text between frames/within objects	■ ■	■ ■	■ ■	■ ■
Fit text to path/Wrap text around objects	■ ■	■ ■	■ ■	■ ■
Set columns/bullets	■ ■	■ ■	■ ■	■ ■
Imports				
AI/EPS/WMF	■ ■ ■	■ ■ ■	■ ■ ■	■ ■ ■
CDR/DXF/PDF	■ ■ ■	■ ■ ■	■ ■ ■	■ ■ ■
PCX/Photo CD/Pict (Macintosh)	■ ■ ■	■ ■ ■	■ ■ ■	■ ■ ■
JPG/TGA/TIFF	■ ■ ■	■ ■ ■	■ ■ ■	■ ■ ■
Standard GIF/Transparent GIF/Animated GIF	■ ■ ■	■ ■ ■	■ ■ ■	■ ■ ■
PNG	■	■	■	■
Exports				
AI/EPS/WMF	■ ■ ■[2]	■ ■ ■	■ ■ ■	■ ■ ■
CDR/DXF/PDF	■ ■ ■	■ ■ ■	■ ■ ■	■ ■ ■
PCX/Pict (Macintosh)	■ ■[3]	■ ■	■ ■	■ ■
JPG/TGA/TIFF	■ ■ ■	■ ■ ■	■ ■ ■	■ ■ ■
Standard GIF/Transparent GIF/Animated GIF	■ ■ ■	■ ■ ■	■ ■ ■	■ ■ ■
PNG/image maps	■ ■	■ ■	■ ■	■ ■
Vector format with URLs	■	■	■	■
Requires plug-in	N/A	■	■	■

(1) Transparent fills refers to true, live, interactive transparencies. (2) From the Windows version of Illustrator 8.0 only. (3) From the Macintosh version of Illustrator 8.0 only. N/A—Not applicable. The product does not have this feature.


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ZD ZIFF-DAVIS
What's Nextranet?
Who knows?
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It's a special new section in every issue of PC Magazine designed to keep networking buyers like you right on the edge.
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trator's technical illustration capabilities. Although the program has some technical tools, including custom grids and guides, global constraints, and a new Smart Guide function that reports whenever your cursor is aligned to adjacent objects, you'll need a plug-in like Hot Door's CADtools if you want to draw to scale or insert dimension lines.

The beta version we tested did not include a functional version of Illustrator's Kodak color-management system, so we were unable to test four-color separations. In addition, Illustrator 8.0 suffered from the slowdowns and crashes we expect from a beta program. Adobe says all these issues will be resolved by the time Illustrator 8.0 ships. Aside from these problems, we are curious to see how well Illustrator's new special effects translate when printed to older PostScript devices; on our tests, when we printed a gradient mesh on a PostScript 2 device, the output displayed artifacts in the JPEG rendering.

Although we'll withhold our final verdict until Illustrator 8.0 ships, its innovative tools and ease-of-use enhancements certainly look very promising.—*Luisa Simone*

Canvas 5.0.3

$400 street (upgrade from versions of Canvas prior to 5.x or any competitive illustration, image-editing, or desktop publishing program, $150). Deneba Systems Inc., Miami; 800-622-6827, 305-596-5644; www.deneba.com; 507 at www.pcmag.com/infolink.

● Canvas has carved is own niche by combining its impressive technical illustration tools with image-editing and desktop-publishing features. Since our last comparative review (April 22, 1997), Deneba has released two updates that offer several enhancements. Chief among the improvements in Canvas 5.0.3 is the addition of Colada, an add-in for publishing Web pages. Although this and other enhancements are noteworthy and Canvas still offers the best set of technical illustration tools in its class, as a general illustration program it falls short of the other packages reviewed here.

Version 5.0.3 includes fixes (first rolled out in an interim 5.0.2 update) for several stability problems—an issue that we noted in last year's review. A complete list of the fixes is available on Deneba's Web site. We did not come across any stability problems during our work with the new version, and owners of earlier editions of Canvas 5 are well advised to get the free upgrade. Other features that did not cause crashes but didn't work correctly, such as PostScript errors that occurred during printing, have also been fixed.

In addition to some minor text-handling enhancements, Canvas 5.0.3 integrates so seamlessly with Colada 2.0, Deneba's new Web authoring tool, that you may hardly know it's there.

Like Corel's Barista technology, Colada converts existing illustrations or documents into one or a series of Web pages. If the Canvas document contains multiple pages (which is possible because of Canvas's publication and presentation features), the pages can be connected with hyperlinks, and Colada will create an entire Web site from one document. More so, Colada allows you to assign a URL to any portion of an image or illustration to convert it into a hot spot.

Using this version of Colada, you can also zoom and pan vector graphics, create Web presentations from Canvas publications and slide shows, and add animation and sound effects. Since Colada is Java-based, like Barista, no browser add-ins or ActiveX controls are required to view Colada-generated pages.

Colada supports five different output formats: Java only, Java and GIF, Java and JPEG, GIF image with links, and JPEG image with links. Because Colada's output can be a combination of vector graphics, bitmap images, and text, the output has a relatively small footprint.

In addition to Colada, Canvas now includes several new features first introduced in Version 5.0.2. A proxy editor has noticeably improved Canvas's performance when you are working with large files. The Transparency Mask feature lets users create alpha channel masks to work with portions of images. And Canvas's tools now support pressure sensitivity for

A shoe horn and a polishing cloth in your room.

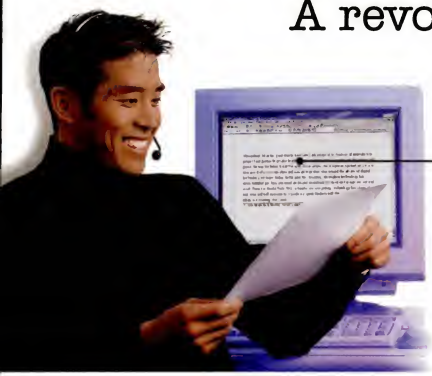
A coffee maker and coffee in your room.

Multi-cup coffee-maker, Maxwell House coffee. Sorry, nothing for your feet. What's really important to you is all that's important to us. That's how to run a hotel. For reservations at Quality Inn or Quality Suites, visit www.qualityinn.com or call 1-800-228-5151 or your travel agent.

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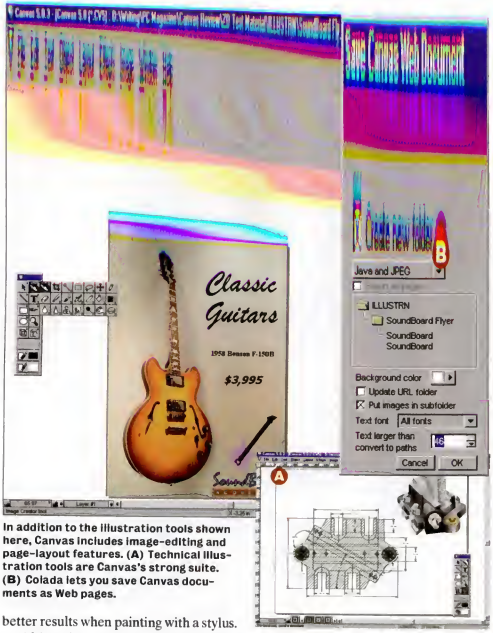
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X2R-0688-05



In addition to the illustration tools shown here, Canvas includes image-editing and page-layout features. (A) Technical illustration tools are Canvas's strong suite. (B) Colada lets you save Canvas documents as Web pages.

better results when painting with a stylus.

Although many of these new features are not directly related to illustration, Canvas is best known for its technical illustration tools. Here the program offers several features that others either do not have or rely on third-party plug-

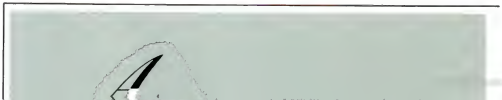
As Deneba readily admits, Canvas will not replace such programs as Adobe Photoshop, CorelDraw, and QuarkXPress, for example. Instead, Canvas continues to find a home in the SOHO and education markets, as well as in larger companies that do not have full-time design professionals, where its blend of illustration, image-editing, and page-layout features is an attractive alternative.—*Will Fastie*

CorelDraw 8

$500 street (upgrade from any previous version or from competitive products, $230). Corel Corp., Ottawa; 800-772-6735, 613-728-8200; www.corel.com; 502 at www.pcmag.com/infolink.

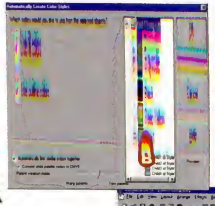
PC MAGAZINE EDITORS' CHOICE

Corel is known for packing a lot into the box, and CorelDraw is no exception, with its hundreds of megabytes of applications, utilities, and clip art. But CorelDraw 8 delivers quality as well as quantity.




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instead of a Dell, Compaq
or HP and free up money
for other luxuries.
Like food.

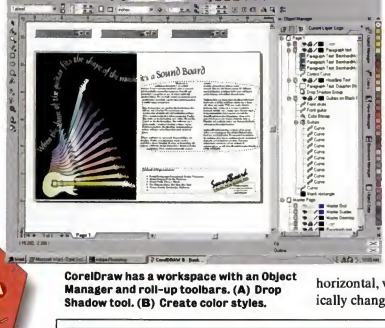




Text tools include columns, bullets, drop caps, hanging indents, linked text boxes, and many word processing and typography commands. Though you can create and edit text directly on your page, any small change in a large text block causes a delay while the screen redraws, so you'll be better off using the text dialog. CorelDraw has no command to flow text around an object automatically, but with the Envelope tool, any object (including a text box) can be reshaped interactively. The Fit Text to Curve command leaves both the text and its path editable.

Thanks to improvements in print output and to enhanced productivity tools, CorelDraw has matured.

As with its sister program, Photo-Paint 8 (which is included with CorelDraw), CorelDraw's interface fills every corner with information. Toolbars, current tool properties, status line, roll-up palettes, and tabbed docked palettes fit together intelligently, giving the user quick access to controls. You can configure the interface to appear like CorelDraw 7, or even Adobe Illustrator or Macromedia FreeHand, and you can save your personal workspace preferences. The on-screen CorelTutor, comprehensive documentation, and thorough online help provide considerable assistance.





CorelDraw has a workspace with an Object Manager and roll-up toolbars. (A) Drop Shadow tool. (B) Create color styles.

Precise numerical controls over size, rotation, and position are on the tool properties bar. But other than the angled guidelines, there's no control over angles. Dynamic dimensioning lines (which can be horizontal, vertical, or angular) automatically change measurement values when

This version of CorelDraw is more efficient. Zoomed views can be named and saved in the Zoom Level window on the toolbar. That way, you can return to that view with a single click-and-drag. Guidelines are now treated as objects, which can be grouped, angled, and/or nudged. Undos are saved with your file, so that you can return to earlier versions.

CorelDraw 8 has more interactive tools and procedures that are done directly on the page rather than through dialogs. This includes greater support for drag-and-drop of effects and colors. For instance, click on an object with the Drop Shadow tool to place the shadow controls, then drag the object to orient and size it. Similarly, use

The radio tuned to a station that will put you to sleep.

A Serta Sleeper mattress.

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their linked objects are resized.

Color options are versatile and powerful, but the controls tend to be dispersed throughout the program. The color palette can pick up, use, and save colors measured by spectrophotometers. Clicking on a swatch in the on-screen strip displays a box of variations of that color. Or, you can interactively mix colors and pick up variations in yet another dialog. But you can't specify spot colors by name.

In the Palette Editor, you can create, edit, and save different color palettes. Auto Create Color Styles picks up all the colors in a design and organizes them in parent/child relationships. Create New Palette from Selection, as well as Create New Palette from Document, saves a color palette based on your design. But the three dialog boxes are not integrated.

Print quality has improved significantly. CorelDraw generated crisp, clean output with bright colors that were nearly identical to those of the screen image. CorelDraw 8 uses Kodak Color Management with ICC profiles. In addition to Hexachrome color support, it includes links to the OPI (Open Press Interface) and DCS (Desktop Color Separations) prepress protocols.

Web tools are almost automatic. URL hot spots are created in Object Properties, and CorelDraw supports a laundry list of export formats including transparent GIF, HTML, Java, JPEG, and PNG. The Publish to Internet wizard steps the user through creating HTML or Corel Barista (the Java-based format) pages appropriate for the Web. On our tests, CorelDraw yielded high-quality images.

CorelDraw 8 is a powerful, feature-rich program for artistic and technical illustration for print or the Web. As if this weren't enough, the suite also includes Photo-Paint 8, CorelDream 3D 8, and several graphics utilities, making it one of the best values in this roundup.—*SWG and DG*

FreeHand 8

$400 street (upgrade from any previous version, $149; competitive upgrade, $199). Macromedia Inc., San Francisco; 800-288-4797, 415-252-2000; www.macromedia.com; 508 at www.pcmag.com/infolink.

● FreeHand is recognized for its ability to maintain perfect color fidelity between screen and printer. The latest version, FreeHand 8, maintains this edge while adding several key features to its illustration arsenal. Throw in Flash animation and expanded GIF support and you've got a program that's ideal for nearly everyone except technical illustrators, who will find FreeHand lacking.

Macromedia loads the FreeHand CD with 493 fonts, more than 10,000 clip art objects, and 370 project templates. The manual includes 48 pages of tutorials, and FreeHand also has simple wizards that set page size, drawing style, and more.

You build projects on a canvas supporting both multiple pages and layers. There are few drawing primitives, but you can easily combine objects and shape them with a Bezier Pen or FreeHand's excellent new Freeform tool. Double-clicking on an object spawns transformation handles for rotation, skewing, and resizing.

FreeHand stores all project colors as chips in the Color List panel. You add colors from included Pantone, TruMatch, and other libraries, or by selecting a color from an imported bitmap or other object with an eyedropper. Imported colors are immediately listed by the color mode you are currently working in.

Our tests revealed some interesting strengths and weaknesses. On the plus side, FreeHand's Auto-trace tool made short work of copying the outline of an imported image, letting us quickly create an editable vector object—in this case, a guitar. But although FreeHand has some new texture-like styles and very flexible gradient options, it lacks a mechanism, such as Corel's Texture, for creating realistic textures. In addition, although FreeHand's new emboss and shadow features create the appearance of depth, they fall short of a true extrusion feature for creating an actual 3-D object.

Still on the plus side, FreeHand's text capabilities remain strong. You can attach text to any object, making shaping text around our test images simple, though we had to kern certain letters when angles got sharp. FreeHand can spread larger

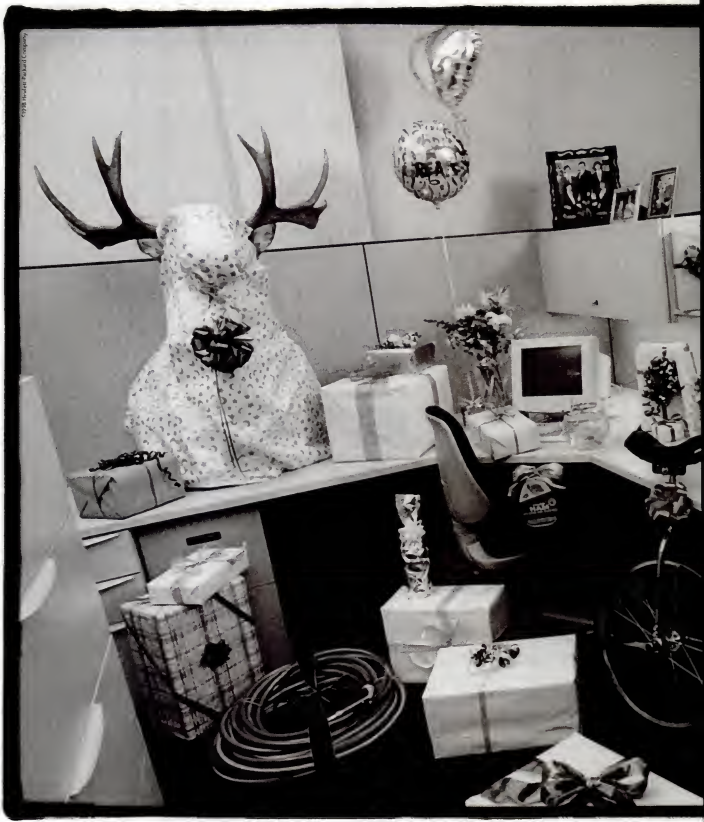
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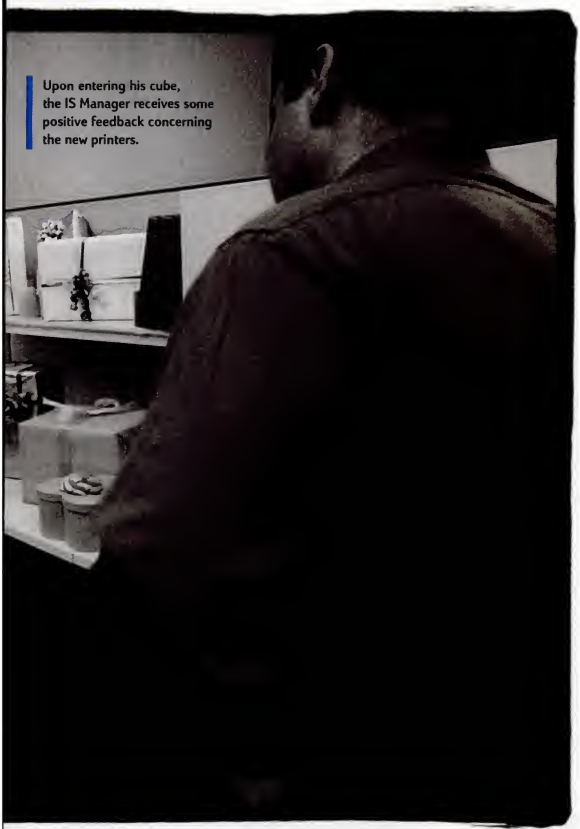
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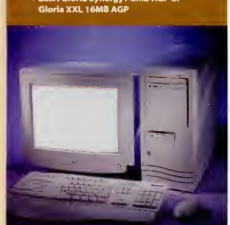
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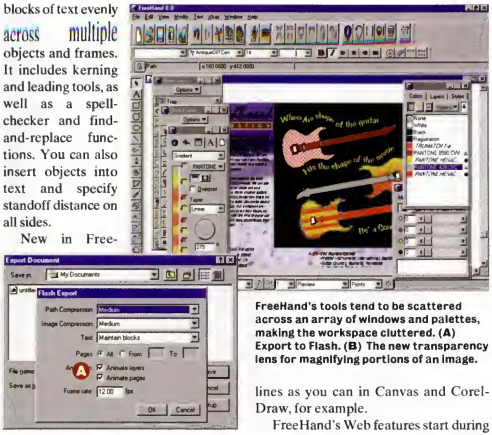
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blocks of text evenly across multiple objects and frames. It includes kerning and leading tools, as well as a spell-checker and find-and-replace functions. You can also insert objects into text and specify standoff distance on all sides.

New in FreeHand 8 is the Lens Effects option, which enables effects such as a magnifying lens and transparency. An image of a glass of red wine, for instance, can darken the object behind it. A snapshot function can capture the magnified image behind the lens, useful for revealing detail in the underlying illustration.



FreeHand's tools tend to be scattered across an array of windows and palettes, making the workspace cluttered. (A) Export to Flash. (B) The new transparency lens for magnifying portions of an image.

Also new is a Graphics Hose that, like Adobe Illustrator's Scatter Brush and Corel's Image Sprayer, spreads images, such as stars or trees, randomly across a canvas. A new Mirror tool can create mirror images of an object or multiple copies distributed along the axis of a circle.

For technical illustrators, FreeHand 8 has little new to offer. You still don't have the ability to set drawing scale, and though you can monitor object size while drawing, you can't measure diameter or radius, or create dynamic dimension lines as you can in Canvas and CorelDraw, for example.

FreeHand's Web features start during design, when you can choose colors from a Web-safe color library. Improved output options include PNG support and the ability to dither and specify palettes for GIF files. Still, comparison tests show that other programs create GIFs with higher color fidelity. FreeHand's key Web-related feature is its support for the popular Flash animation format. With FreeHand, you get complete control over parameters such as the path, image compression, and frame rate. Combined with FreeHand's automated design tools and Release to Layers Xtra, path-based motion, pulsing color, and other effects can be easily converted to compact Flash.

FreeHand offers several useful output features, including printer profiles and a Collect for Output feature that places required components, such as fonts and embedded images into one directory for transfer to a service bureau. In addition, output tests revealed that FreeHand has lost none of its printing prowess. It produced crisp, color-accurate output consistent with the screen display.

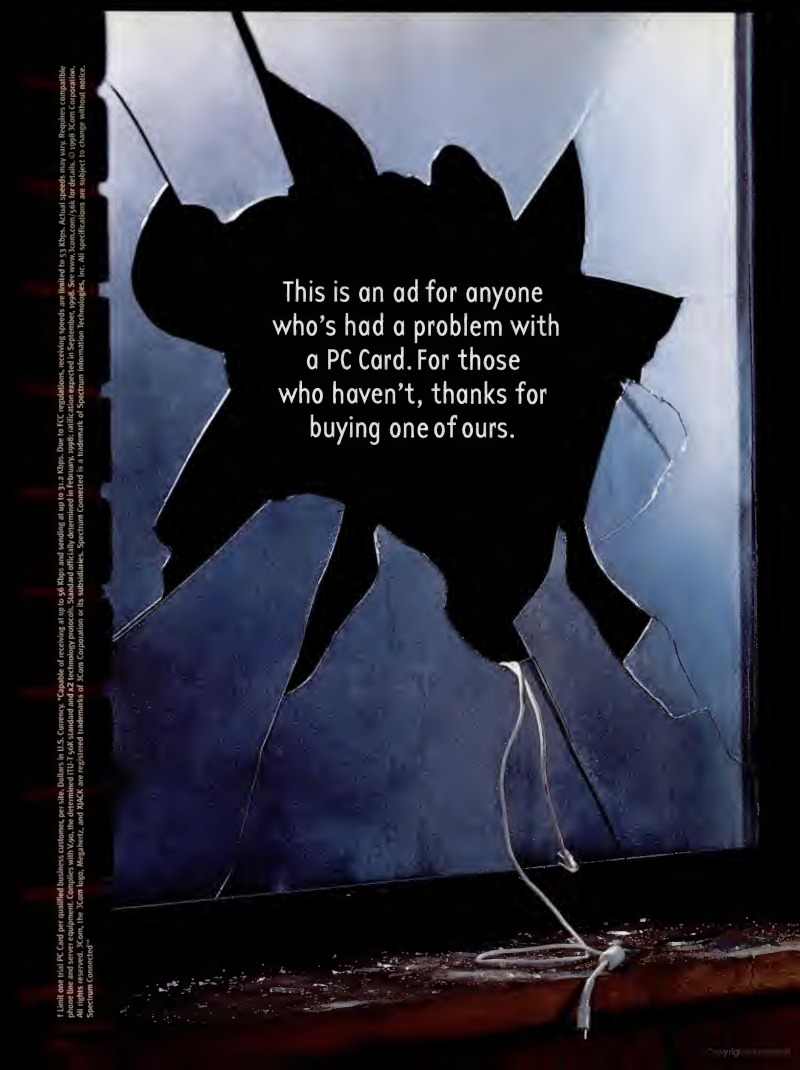
FreeHand may not be the most feature-rich professional illustration program, but its dead-on color output and Flash support make FreeHand one of the top programs for artistic illustration. —*Jan Ozer* PC

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Net Tools



Server NICs with Tricks

Packed with features that use multiple ports and increase fault tolerance, these NICs go a long way in optimizing your LAN.

By Les Freed

The Network Interface Card (NIC) is one of the least expensive and most overlooked server components. But it's also one of the most important. Because every bit of data traveling to or from a server must pass through the NIC, the failure of a $99 card can bring a $15,000 server to its knees.

Until recently, many NIC vendors offered a single product line for both client and server PCs. Now, a new breed of NICs designed specifically for server duty provides increased reliability and better overall performance on your LAN, with only a minimal investment in hardware.

For this story, we asked for PCI-based 10/100-Mbps server NICs that run on both Windows NT and NetWare networks. We accepted single port cards but requested multiport versions whenever possible. We netted eight NICs from five vendors, with Adaptec, Intel, and Matrox each supplying two cards.

The cards we tested include single-port, dual-port, and quad-port models—with two NICs designed with on-board processors (from Intel and Matrox). List prices range from $85 for the single-

ILLUSTRATION BY TERRY MAURA

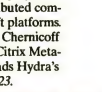
INSIDE



FROM THE NIC UP: Looking for ways to break the bottleneck? Consider upgrading your server NICs. Contributing editor Les Freed and ZD Labs' Martin Wong test eight cards that pack plenty of features for improving reliability and speeding up performance.

CORPORATE VIDEO, CHEAP: Companies looking for a conference-room videoconferencing solution that won't break the bank are in luck. Contributor Ted Needleman puts the Intel TeamStation 4.0 through its paces. *Page 223.*

HYDRA REARS ITS HEADS: Long known by the catchy code name Hydra, the Microsoft NT Terminal Server is here—letting you deploy server-centric distributed computing on Microsoft platforms. Contributor David Chernicoff tests it along with Citrix MetaFrame, which extends Hydra's capabilities. *Page 223.*



MANAGEMENT MADE EASIER? Geneva Software's AlertPage Enterprise 4.1 aims to take some of the burden off managing your network. Find out whether contributor Greg Alwang thinks it delivers on its promises. *Page 224.*

HANGING YOUR E-SHINGLE: Setting up an e-commerce site gets easier. Contributor John Garris checks out new versions of Lotus Domino Merchant 2.0 and Microsoft Site Server Commerce Edition. *Page 226.*

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SERVER NICs

port Adaptec model to $1,199 for the four-port Matrox 100 Multiport NIC+. Although Matrox makes the only four-port cards represented here, by press time, offerings from Adaptec, Phobos, and ZYNX will also be available.

Our testing proved that higher-priced, multiport NICs don't necessarily buy you faster speeds per port. Although our tests showed that expensive on-board processors did speed performance in some instances, some of the lowest-cost, single-port products we tested—the Adaptec ANA-69011 Single32 Fast Ethernet NIC ($85 list), the Intel PRO/100+ Server Adapter ($119 list), and the 3Com Fast EtherLink Server NIC ($199 list)—were the fastest performers. But the two dual-port NICs from Adaptec and Compaq are also worthy and save you a server slot.

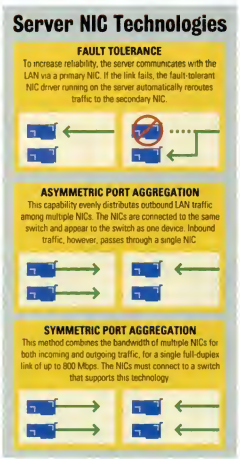
Beyond design, look for NICs that demonstrate the best balance of high throughput and low CPU utilization. Moreover, you'll also want to take into account your network operating system. For details, turn to "Where Did My CPU Go?"

SMART NIC TRICKS

To reap some of the benefits of server NICs, you need more than one port. Implementing multiple NICs lets you take advantage of software-based fault-tolerance, asymmetric port aggregation, and symmetric port aggregation capabilities.

Fault tolerance protects the server's LAN link by using redundant NICs. If one NIC fails, the fail-over software deactivates the faulty NIC and switches LAN traffic to an alternate card. The rerouting takes place almost instantaneously, without human intervention. All the NICs we tested include fail-over capability.

Most of these NICs provide *asymmetric port aggregation* (also referred to as *asymmetric load balancing* or *asymmetric trunking*). This technology distributes outbound server traffic between two or more cards, providing a wider data pipe. The NICs act as a team that appears as a single device with one network address. Asymmetric port aggregation is ideal for Web servers, e-mail servers, and other applications where most of the traffic flows in one direction from the server to the client PCs. This method also provides fault tolerance; if one of the NICs in a team fails, the others compensate.



A companion technology is *symmetric port aggregation* (or *symmetric load balancing* or *symmetric trunking*). This method combines two or more connections into a wider pipe that can transmit data in both directions. Combining several 100-Mbps connections lets you obtain claimed Gigabit Ethernet speeds without replacing hubs or switches. And it, too, provides fault tolerance.

The Intel and Compaq cards are the only NICs here to offer this capability. Symmetric port aggregation requires a specific vendor's Ethernet switch. These NICs operate with Cisco's Fast EtherChannel technology—but only in conjunction with a *Cisco* Ethernet switch. The single-port Adaptec and the 3Com NICs will add this feature by year's end.

In addition, two NICs (the Intel PRO/100 Intelligent Server Adapter and the 3Com Fast Etherlink Server NIC) provide Virtual LAN (VLAN) capability. This IP-based technology lets a single server link (one NIC or a team of NICs) carry traffic for up to 64 logical subgroups created via software. It provides additional bandwidth management and security features and helps reduce the administrative overhead required to manage workstation moves and changes. As with both types of bandwidth aggregation, VLAN technology lacks an industry-wide standard, so any VLAN

EDITORS' CHOICE

- Intel PRO/100+ Server Adapter

PC MAGAZINE EDITORS' CHOICE

These eight server-specific single and multiport network adapters provide an array of innovative features that improve manageability, reliability, and performance. Though nearly every product we tested brings something new to the table, the single-port Intel PRO/100+ Server Adapter ($119 list) stands above the rest, with impressive features and performance at a bargain price.

The PRO/100+'s feature set provides a laundry list of the capabilities in this emerging category of NICs. It boasts fault tolerance and asymmetric port aggregation. And it was one of only three cards to work with Intel's Fast EtherChannel, gaining symmetric port aggregation as well. In addition, it was just one of three cards to feature Compaq's Hot Plug technology, which lets administrators switch components without powering down the server. The PRO/100+ also has the most extensive set of drivers that we saw, so you can use it with almost any operating system your server is running.

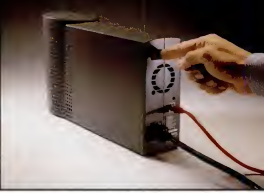
But for server NICs, features mean nothing without performance to back them up. The Pro/100+ demonstrated outstanding speeds, turning in the highest average throughput in segmented networks under both NetWare and Windows NT, and above-average throughput on flat networks. Even without an on-board processor, the card showed consistently low CPU utilization, especially under NetWare.

And good performance doesn't mean much if you don't have the management capabilities to keep the card running. The PRO/100+ is one of the only cards to have dynamic code loading, which lets the host server automatically download firmware onto the NIC to optimize performance. In addition to being DMI 2.0–compliant, the Pro/100+ is certified under Intel's Wired For Management 1.1 specification and includes SNMP agents to make integration with your software as easy as possible.

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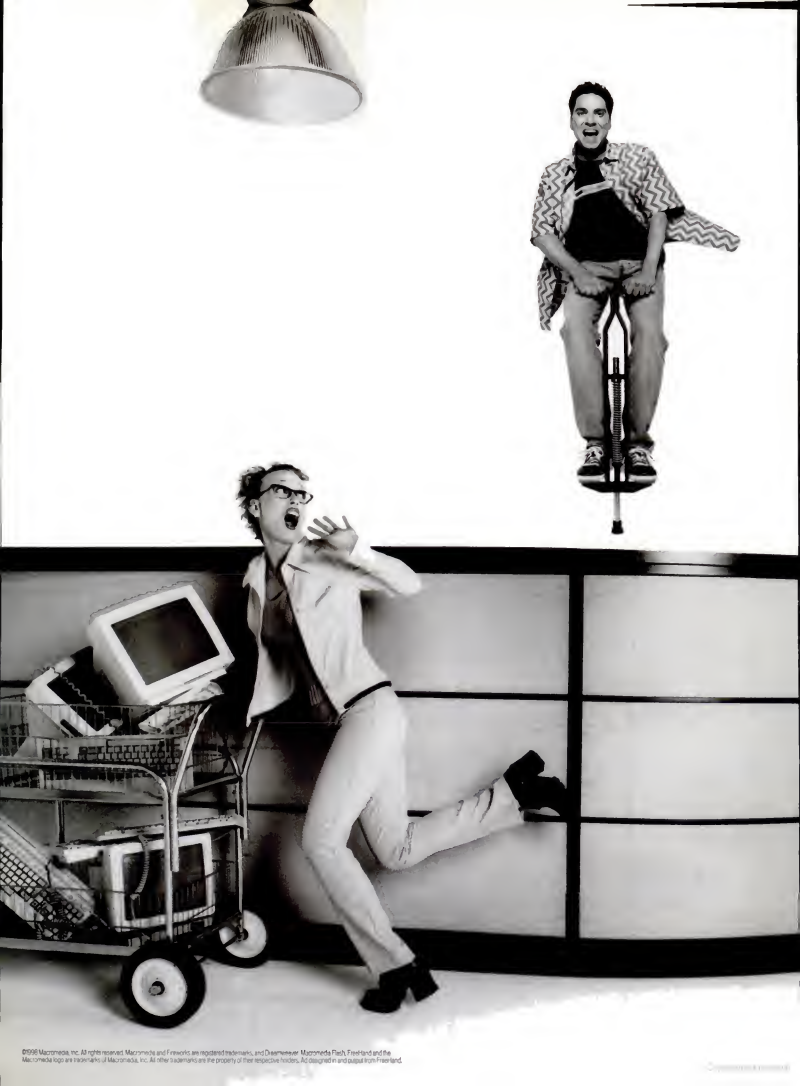
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NICs you use must be compatible with your VLAN switches. If you're interested in gaining fault tolerance and asymmetric port aggregation with your existing NICs, consider the software solutions highlighted in the sidebar "Teach Old NICs New Tricks."

UNEXPECTED FEATURES

Many of the products we tested include significant features we haven't seen before. Three cards—the Compaq product and the two units from Intel—are Hot Plug–capable, which means that when used with a Hot Plug–compatible server (currently available only from Compaq), system administrators can hot-swap server NICs without bringing down the server. Both the Intel and 3Com NICs employ a driver with *dynamic-code loading* technology, which lets the NOS driver download firmware onto the NIC that is optimized for the server NOS and protocol in use. This driver software automatically senses an error condition on the NIC and takes the appropriate action, such as automatically resetting itself if the on-board interrupt controller stops responding. All the NICs we tested provide PCI bus mastering, a capability lacking in many client NICs. This lets the NIC handle network requests directly, without interrupting the host CPU. Read on to see which server NICs deserve a place in your LAN.

Adaptec ANA-69011 Single32 Fast Ethernet NIC, ANA-6922 Duo 2-Port Fast Ethernet NIC

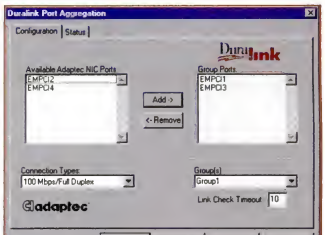
Single: $85 list. **Duo:** $375. Adaptec Inc., Milpitas, CA; 800-442-7272, 408-957-7274; www.adaptec.com; 900 at www.pcmag.com/infolink.

● The Adaptec NICs we tested are good choices, each with its own bragging rights. The Adaptec ANA-69011 Single-32 Fast Ethernet NIC ($85 list), the least expensive unit here, demonstrated impressive throughput. But until its new drivers are released, it will lack some competitive features, and it had high CPU utilization under NetWare.

If you're considering a dual-port card, the Adaptec ANA-6922 Duo 2-Port Fast Ethernet NIC ($375 list) provides a richer feature set than the Single and above-average performance and low CPU utilization. Though a bit slower than the Compaq dual-port on most tests, the Duo uses a single interrupt, further preserving server resources.

Although Adaptec markets the card primarily as a server NIC, the Single's reasonable price and excellent speed make it a good choice for high-performance desktop machines. However, our tests found its CPU utilization to be high.

As we prepared this review, Adaptec was working on a major driver update for the Single. The current drivers don't support symmetric port aggregation, PCI Hot Plug, or Cisco ISL VLAN, but all of these features should be in place by year's end.



EASY GOING: *We found Adaptec's configuration menu among the easiest to navigate, with simple layout and controls.*

BENCHMARK TESTS

Server NICs

PC MAGAZINE LABS

Raw speed is important, but it's not the whole story. How heavy a burden the card puts on a server's CPU is just as important. The best performers demonstrate both high throughput and low CPU utilization.

NIC vendors continue to seek ways to alleviate network bottlenecks. In the past, when your network failed to move data to the server quickly enough, you had only two remedies: break your network into smaller segments by installing additional server NICs, or migrate to a faster technology. Both methods are costly, in new equipment and time spent reconfiguring the LAN. Asymmetric and symmetric port aggregation technologies present a compelling alternative by letting you combine NIC ports, thereby creating a wider pipe that lets more data pass through quickly.

Our testing shows results from four separate configurations: **Segmented Networks** and **Flat Networks** under NetWare and Windows NT. The Segmented Network's configuration represents a network using traditional segmentation, which divides the LAN into multiple wiring segments. A Flat Network configuration lets you maintain a single segment, using asymmetric port aggregation software. On comparing the scores for each, you'll see that in most instances asymmetric port aggregation reduces throughput and can drive up CPU utilization, though most cases, not significantly. In making a buying decision, you'll need to weigh the cost of labor and equipment that implementing segmentation incurs against the performance loss of using a Flat Network scheme.

To evaluate speed, we considered the **Average Throughput** and **Average Utilization** for each CPU in our dual-processor server under both IntranetWare 4.11 and Microsoft Windows NT 4.0. Two single-port cards—the Intel PRO/100 Intelligent Server Adapter and the Intel PRO/100+ Server Adapter (our Editors' Choice)—produced top speeds, as did the Adaptec ANA-69011 Single32 Fast Ethernet NIC and the Compaq NC3122 Fast Ethernet NIC.

To express throughput and CPU utilization in a combined score, we calculated the **Performance/Efficiency (P/E) Index**. To derive the number, we divided each NIC's Average Throughput score by the average of the two CPU Average Utilization scores. Here, too, the Intel PRO/100 produced the top rating under NetWare, whereas the Matrox Multiports performed poorly.

Though the Matrox cards achieved the highest P/E score on our segmented Windows NT tests, the numbers are misleading. The cards' lackluster throughput conserved CPU cycles, thus leading

Asymmetric port aggregation features are available for the Duo with the DuraLink Port Aggregation software. The Single turned in fine performance scores, finishing in the top third for throughput across our tests.

The Duo hosts two RJ-45 Ethernet connectors on the rear panel, plus three LEDs for each port. It is essentially two independent NICs on a single card, but unlike the Compaq dual port, they share one PCI interrupt—an important consideration for crowded server PCs. Besides Windows NT and NetWare, the Duo includes drivers for SCO UnixWare.

Although not as speedy as its single-port sibling, the Duo turned in respectable performance, as well as low CPU utilization scores on the segmented network.

Adaptec uses its own DuraLink software for failover and for asymmetric port aggregation. Although the DuraLink Failover software is bundled with both models, the DuraLink Port Aggregation software comes only with the Duo. Adaptec's products are backed by a limited lifetime warranty. Free (but not toll-free) technical support is available during regular business hours.

The Single is a good performer, but to optimize its value, wait for the new drivers. The Duo is a good bet, especially if you're short on server resources.—*LF*

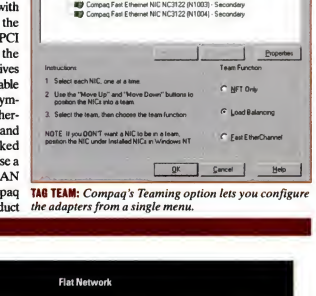
Compaq NC3122 Fast Ethernet NIC

$340 street. Compaq Computer Corp., Houston; 800-345-1518; www.compaq.com.

● The only vendor here to manufacture servers and NICs, Compaq Computer Corp. takes an integrated approach to network hardware that pays off handsomely. The dual-port Compaq NC3122 Fast Ethernet NIC ($340 street) boasts a well-rounded feature set and the overall best performance among multiport NICs. Though it's a good choice for anyone, the product's integration capabilities make it the hands-down choice among Compaq server users.

The NC3122 features two ports with LEDs on each port. In contrast to the Adaptec and Matrox units, it uses a PCI interrupt for each port just like the single-port NICs do; this trade-off gives you good performance and an available PCI slot. The Compaq provides symmetric port aggregation via Fast EtherChannel. The card's fault tolerance and asymmetric port aggregation worked well, and the vendor plans to release a software upgrade that includes VLAN support by press time. The Compaq card uses an Intel chip set, a by-product of their technology-sharing relationship.

The unit also includes features designed to work exclusively with Compaq servers. Not surprising, the NC3122 is one of only two cards here to work with Compaq's Hot Plug technology, which enables hot-swapping components on equipped servers. SNMP support lets it integrate easily with Compaq's Insight Manager, which comes bundled with the servers, or any other SNMP management software. Moreover, the vendor



TAG TEAM: *Compaq's Teaming option lets you configure the adapters from a single menu.*

Performance Tests

▲ High scores are best. ▼ Low scores are best.
Bold type denotes first place.
PC denotes Editors' Choice

	Segmented Network				Flat Network			
	Average Throughput (Mbps) ▲	Average Utilization: CPU 1 ▼	Average Utilization: CPU 2 ▼	Performance/ Efficiency Index ▲	Average Throughput (Mbps) ▲	Average Utilization: CPU 1 ▼	Average Utilization: CPU 2 ▼	Performance/ Efficiency Index ▲
INTRANETWARE 4.11								
Adaptec ANA-69011 Single32 Fast Ethernet NIC	343.3	62.4%	10.0%	7.43	N/A[2]	N/A[2]	N/A[2]	N/A[2]
Adaptec ANA-6922 Duo 2-Port Fast Ethernet NIC	296.9	24.1%	9.0%	17.94	287.4	50.1%	10.0%	9.56
Compaq NC3122 Fast Ethernet NIC	347.7	21.4%	6.0%	22.14	243.5	22.7%	6.0%	16.96
PC Intel PRO/100+ Server Adapter	**349.6**	15.2%	6.0%	32.98	243.1	23.0%	6.0%	16.76
Intel PRO/100 Intelligent Server Adapter	344.9	**8.0%**	**5.0%**	53.01	**341.3**	**7.8%**	**5.0%**	**53.42**
Matrox 100 Multiport NIC	261.3	57.5%	15.0%	7.21	253.3	43.6%	14.0%	8.80
Matrox 100 Multiport NIC+	116.1	34.9%	N/A[1]	3.38	41.4	30.2%	N/A[1]	1.37
3Com Fast EtherLink Server NIC	**349.6**	8.1%	**5.0%**	**53.37**	N/A[2]	N/A[2]	N/A[2]	N/A[2]
MICROSOFT WINDOWS NT SERVER 4.0								
Adaptec ANA-69011 Single32 Fast Ethernet NIC	268.2	98.8%	98.9%	2.72	N/A[2]	N/A[2]	N/A[2]	N/A[2]
Adaptec ANA-6922 Duo 2-Port Fast Ethernet NIC	249.4	96.2%	96.9%	2.60	229.6	97.9%	100.0%	2.34
Compaq NC3122 Fast Ethernet NIC	272.8	99.1%	98.9%	2.76	217.3	99.5%	98.4%	2.20
PC Intel PRO/100+ Server Adapter	**283.7**	**98.0%**	**99.1%**	2.89	223.9	99.8%	99.2%	2.25
Intel PRO/100 Intelligent Server Adapter	266.9	99.8%	100.0%	2.66	209.4	99.9%	98.8%	2.11
Matrox 100 Multiport NIC	209.4	100.0%	100.0%	2.09	136.6	88.9%	96.0%	1.50
Matrox 100 Multiport NIC+	169.8	97.4%	97.3%	2.29	115.1	98.0%	99.9%	2.10
3Com Fast EtherLink Server NIC	258.2	99.8%	99.9%	2.59	N/A[2]	N/A[2]	N/A[2]	N/A[2]

N/A (1)—Not applicable: The Matrox 100 Multiport NIC+ is not compatible with SMP Novell servers. N/A (2)—Not applicable: This product does not support asymmetric port aggregation.

to artificially high scores. The Multiport NIC+ also scored poorly on our flat NetWare tests. Matrox and NSI believed our results were incorrect and were unable to duplicate the scores in their labs. We worked with them for several days but were unable to solve the problem.

▲ Differences in CPU utilization are readily apparent under NetWare. Under Windows NT, however, in most cases both server processors are operating at near maximum capacity. This high utilization, unfortunately, weakens the value of the P/E Index under Windows NT. (For more information on differences in operating systems, turn to the sidebar "Where Did My CPU Go?")

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DEH3481: 3Com Superstack II Dual speed 500 10/100 12 Port	$679.99

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is developing a universal driver for all its products that will let both client and server-side systems use the same driver.

On our tests, the Compaq unit performed well under both NetWare and Windows NT, finishing near the top for each network operating system on our tests. Under NetWare, the Fast Ethernet also demonstrated low, consistent CPU utilization.

The NC3122 includes a limited lifetime warranty and free, round-the-clock technical support. If you stick with the Compaq product line, you can avail yourself of unified technical support and a warranty that covers your entire server package.

Compaq server users will love the NC3122's tight integration. But anyone looking for a multiport card is sure to be impressed as well.—*Martin Wong*

Intel PRO/100+ Server Adapter; PRO/100 Intelligent Server Adapter

PRO/100+: $119 list. **PRO/100 Intelligent:** $399. Intel Corp., Santa Clara, CA; 800-549-4725; www.intel.com; 901 at www.pcmag.com/infolink.



Intel's experience in the NIC marketplace shines through with its server-specific offerings. Its two single-port units clearly target different markets, but they each include software that provides a boatload of useful capabilities. The Intel PRO/100+ Server Adapter ($119 list) is geared to the general file-and-print-server market, whereas the Intel PRO/100 Intelligent Server Adapter ($399 list)—which includes an on-board i960 processor—is appropriate for high-volume servers with processor-intensive tasks. Though both provide top-notch performance and rich features, the PRO/100+'s price makes it vault ahead of the pack to win our Editors' Choice.

The PRO/100+ includes the most diverse range of drivers that we saw: NetWare 3.x and 4.1, SCO UnixWare, Sun Solaris, Windows NT Server 3.51 and 4.0, and Windows 95. Intel's technology-sharing relationship with Compaq enables the PRO/100+ to be one of the earliest supporters of Compaq's new Hot Plug PCI technology, which allows you to hot-swap NICs in Hot Plug–compatible servers.

The PRO/100 Intelligent Server Adapter includes an on-board i960 CPU and 1 MB of cache RAM to lessen server CPU utilization. Moreover, the PRO/100 is one of two cards here that can operate as part of a virtual LAN (3Com is the other). The PRO/100 can support 64 VLAN connections.

The performance for both cards was outstanding. The PRO/100+ delivered the highest throughput on our segmented network on both NetWare and Windows NT—with above-average throughput on the flat network. The Intelligent Server's CPU helped it achieve the lowest CPU utilization scores under NetWare and the highest speeds on the NetWare flat network.

Included with both cards, Intel's Adapter Teaming software was easy to install and manage. Aside from fault tolerance, it provides what Intel calls *Adaptive Load Balancing* (asymmetric port aggregation), as well as symmetric port aggregation, using Cisco's Fast EtherChannel (FEC) technology, in conjunction with Cisco switches.

The management capabilities of these NICs are also extensive. Both are SNMP-manageable, support DMI 2.0, and include dynamic code loading, which lets servers download optimized firmware on their NICs to improve performance. The PRO/100+ is also the only card here that conforms to Intel's Wired for Management 1.1 specification, which is designed to ease management. If you get into trouble, all Intel NICs are backed with a lifetime warranty, 90-day money-back guarantee, and free technical support in North America.



INTEL INSIDE: *The Intel Pro/100 Intelligent Server Adapter has an on-board i960 processor.*

Both Intel units provide exemplary features and impressive performance. The PRO/100+ comes out ahead, however, by providing them at an unbeatable price.—*LF*

BENCHMARK TESTS

If you're after spectacular performance on a NetWare network and have the server slots to spare, our tests show that four of Intel's PRO/100s (each with its own on-board processor) is the ultimate configuration. Intel achieves the fastest speeds in NetWare by off-loading part of the protocol stack from the server straight onto the PRO/100's CPU. But Windows NT 4.0 is unable to take advantage of this method, demonstrating only a slight performance improvement on NICs with i960 processors. Microsoft claims that Version 5.0 of the Network Driver Interface Specification (NDIS)—which will accompany Windows NT 5.0—will have this capability. In the meantime, Windows NT shops may want to hold off buying i960-enabled server NICs.

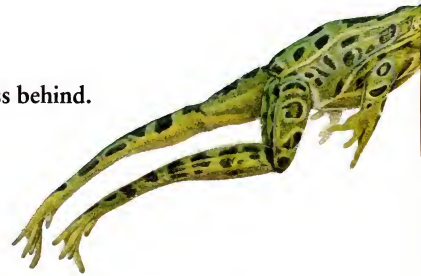
Adaptec's entries delivered dissimilar results, with the Single besting the Duo in throughput on our segmented network. The Single's speed can be attributed to a new Adaptec-manufactured Ethernet controller chip that replaces the Duo's older controller. Adaptec is developing dual and quad cards that use the new chip.

The methods that Intel, Compaq, and Adaptec use to perform asymmetric port aggregation merits brief explanation. The software binds the networking protocol to a single primary port, which is the only link for sending and receiving data. The software sits between the protocol and the NIC and distributes ongoing traffic evenly to all NICs in its aggregation group.—*Analysis written by Kevin Young*

How We Tested

We used two identical test-beds and configured both a flat and a segmented network. We distributed 40 clients over four switches, with each four-port NIC configuration divided into one port per switch. We ran our NetBench 5.01 NIC test, which reads data sequentially from a shared 48MB file located on the server. We used Compaq 1600R servers with dual 266-MHz Pentium II CPUs and 512MB of RAM. The clients were 28 Dell Dimension XPS Pro200n 200-MHz systems and 12 Dell OptiPlex GXa 300-MHz systems, each with 32MB of RAM. The Dimensions had Intel's PRO/100B NICs installed; the OptiPlex used Intel Pro/100+ NICs. We ran full-duplex to the server and half-duplex to the clients, using Windows NT 4.0 with Service Pack 3 and Microsoft NDIS HotFix (which many NICs require for asymmetric port aggregation) and IntranetWare 4.11 with Support Pack 5B. To track CPU utilization, we used Performance Monitor on Windows NT and XStat with CPU NLM on IntranetWare.





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Matrox 100 Multiport NIC, 100 Multiport NIC+

Multiport NIC: $540 street. **Multiport NIC+:** $960. Matrox Networks, Dorval, Quebec, Canada; 514-685-7230; fax, 514-822-6272; www.matrox.com; 902 at www.pcmag.com/infolink.

● Need to add more ports to your server but can't spare the PCI slots? You may want to consider a multiport NIC. The Matrox 100 Multiport NIC ($540 street) offers four 10/100-Mbps Ethernet ports on a single large board. The Matrox 100 Multiport NIC+ ($960 street) adds to this design an Intel i960 CPU and Fast Ethernet switching. As with most multiport configurations, we expected the Multiports' performances to trail those of the single and dual-port competition, but the products showed exceptionally poor performance and proved to be weak competitors in other areas as well.

Drivers are included for Windows NT 3.51 and 4.0 and NetWare 3.12 and 4.x. The cards are installed as four distinct NICs, with two LEDs per port. In addition, the Multiport NIC+ includes software that lets it operate as a four-segment Ethernet switch. The Multiports' main appeal is that they save you three PCI slots, an important draw if your server is near capacity. The Multiport NIC uses two PCI interrupts, whereas the Multiport NIC+ uses one, further economizing hardware resources.

Though we had no difficulty installing any of the Matrox drivers on our test systems, the Multiport NIC+ doesn't work currently with dual-processor NetWare servers, which required us to test it on a single-CPU system. Although the Multiport NIC+ turned in the lowest CPU utilization score under Windows NT, this was because of the universally low throughput both cards exhibited.

Unlike most of the vendors in this roundup, Matrox does not provide its own fault tolerance and asymmetric port aggregation software. Instead, it includes a 90-day trial version of Network Specialists' Balance Suite software (see the sidebar "Teach an Old NIC New Tricks"). Currently, Balance Suite is the only product besides Cisco's Fast EtherChannel that can perform a form of symmetric port aggregation and it does not require a connection to Cisco hardware. To use Balance Suite for more than 90 days, however, you'll have to shell out an additional $395.

Moreover, the Matrox cards are also missing some features that are standard fare on most 10/100-Mbps NICs, such as auto-switching. Switching a port from Ethernet to Fast Ethernet required us to make a manual change to the server driver with the configuration utility. The cards also lack diagnostic software and DMI



FOUR PORTS, NO WAITING: *The Matrox 100 Multiport NIC and 100 Multiport NIC+ cards both come with four ports each.*

NETWORKOPERATING SYSTEMS

Where Did My CPU Go?

NetWare is faster than Windows NT: There's no big surprise in that. On our server NIC tests, the Intel PRO/100 Intelligent Server Adapter delivered 341-Mbps throughput on our flat network with NetWare, and 209 Mbps with Windows NT. We were surprised, however, to find how differently the NICs interacted with the server's CPUs under each operating system.

Our tests proved that most of the vendors here provide excellent balance between NIC throughput and server CPU utilization for NetWare. But in every case, our tests for Windows NT brought the system to its knees. Even on dual-processor servers, the CPU utilization with Windows NT averaged about 90 percent on both processors, whereas with NetWare, utilization stayed roughly in the 10 to 50 percent range across all products on the primary CPU.

In recommending a server NIC, we caution readers to look beyond sheer throughput and consider the impact on system resources—most notably, processor utilization. Windows NT throws that measuring stick to the floor. What does this mean to Windows NT shops? Higher-priced NICs with on-board Intel i960 processors will buy you nothing extra. You're better off spending your money on additional system CPUs for your server and buying a lower-priced NIC.

None of the NIC vendors we spoke with seemed surprised at our findings. Most look to Microsoft's release of Windows NT 5.0 to remedy the situation. Several NIC manufacturers represented here point the finger at NDIS (Network Driver Interface Specification), and our testing bears this out.

The NDIS layer sits between the networking protocol stack and the NIC driver, much like NetWare's ODI (Open Datalink Interface) specification. Vendors we talked with feel that NDIS is much less efficient than ODI and claim it as the direct cause of the NICs' high CPU utilization.

Microsoft disagreed with this conclusion, offering us several tuning parameters they felt would improve performance. Although some, such as adjusting the TCP window size, may be useful in specific situations, none of the vendors explicitly suggested we use them before testing.

Besides NDIS, another contributing factor to high CPU utilization might be the modular nature of Windows NT's architecture, which introduces module-to-module communication overhead. This modularization prevents a malfunctioning application or process from bringing down the entire system. NetWare does not follow the safer compartmental paradigm, and consequently, avoids much of the inherent overhead. Though the result is faster throughput, NetWare's architecture is more appropriate for file serving than for running general-purpose applications.

Finally, an obvious contributor to performance differences is our choice of protocols. For the server NIC tests, we used IPX for NetWare and IP for Windows NT, which aren't directly comparable. We based our choices on pretesting a number of client scenarios. Neither Microsoft nor Novell, however, felt that protocol choice alone could lead to the performance differences we experienced. Our results were likely caused by a combination of NDIS, modularization, and protocols.—*Kevin Young and Jeffrey G. Witt*

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*Rack model

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SmartNet for 1600 Series routers $135.77 CDW 93252

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2.0 support to ease management, although they include SNMP agents. Matrox's three-year warranty is the shortest here, but the company provides toll-free technical support.

Though getting four ports in one card may be appealing, you would be better served looking at the other multiport NICs in this roundup.—*LF*

3Com Fast EtherLink Server NIC

$140 street. 3Com Corp., Santa Clara, CA; 800-638-3266, 408-764-8000; www.3com.com; 903 at www.pcmag.com/infolink.

● The single-port 3Com Fast EtherLink Server NIC ($140 street) is touted as a server NIC of high reliability and performance. Though the company backs up the claim with superb performance and extensive troubleshooting and management capabilities, the card's lack of some competitive features and SNMP agents kept us from making an unconditional recommendation.

The Fast EtherLink contains three activity LEDs on the rear panel. Rather than using an on-board CPU to ease server processor utilization, the card employs a 3Com-developed custom ASIC chip that optimizes data throughput between the NIC and the PCI bus. 3Com says that this technique, called *Parallel Tasking II*, provides much of the benefit of an on-board CPU without the expense and power consumption. Our tests bore this out, at least under NetWare, where the Fast EtherLink showed extremely low CPU utilization and top-notch throughput. Speeds under Windows NT were above average.

Whereas the card lacks port-aggregation software—featured in all the other cards we tested except Adaptec's Single unit—this software is in development, with expected completion by fall. The current product provides VLAN support when connected to compatible switches, an advanced feature seen elsewhere at this roundup's price.

ALTERNATIVESOFTWARE

Teach Old NICs New Tricks

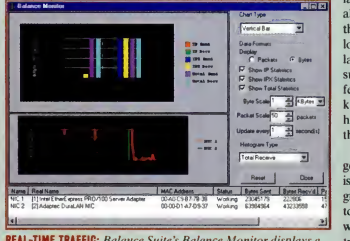
If you want to increase the reliability and performance of your Windows NT or NetWare servers but aren't ready to swap your existing NICs, consider software-based solutions from IP Metrics and Network Specialists (NSI). These products provide fail-over and load-balancing capabilities for your existing hardware.

We tested the Windows NT version of IP Metrics' **NIC Express Version 1.0** ($200 street) and Network Specialist's **Balance Suite Version 2.5** ($400 street). They each work with IP, IPX, and NetBEUI protocols, and we found the programs easy to install in less than 15 minutes.

NIC Express works with multiple NICs of any type supported by your NOS, whereas NSI recommends using Balance Suite with matched sets of NICs only. Nevertheless, we tested each program using two dissimilar NICs—Adaptec's Duo unit and Intel's Pro/100 unit—and experienced no problems.

On installation, NIC Express uses a simple control-panel interface that let us assign the NICs to one or more groups. This makes it easy to distinguish the NICs in each group. It records NIC failures in the Windows NT event log and will notify you via an alert. SNMP support also let us send an SNMP Trap event to an SNMP monitor program. The program maintains a running traffic count by group and by individual NIC, viewable from the server's network control panel.

NIC Express also includes a fail-safe mechanism that lets you set the number of times a NIC can fail and restart. Once the NIC exceeds the threshold, it takes the NIC off-line until you manually reinstate the link. The current version requires that you edit the Windows NT registry to change the threshold setting, but IP Metrics says that a new version—expected by press time—will include this feature. (IP Metrics Software Inc., Euless, TX; 817-358-1007; fax, 817-358-1026; www.ipmetrics.com; *904 at www.pcmag.com/infolink.*)



REAL-TIME TRAFFIC: *Balance Suite's Balance Monitor displays a color-coded picture of NIC traffic.*

To test failover capabilities, we started a network-loading protocol-analyzer program on the server, then randomly disconnected NIC cables. Both Balance Suite and NIC Express caught each failure within approximately 1 second, then automatically rerouted LAN traffic to the working NIC. When we replaced the cable, traffic flow resumed on both NICs almost immediately and was distributed evenly at all levels of network loading.

Whereas NIC Express balances outbound traffic only, Balance Suite attempts to balance inbound traffic as well. It does this by reassigning the physical MAC address of the incoming NIC on the fly. But this method allows only one incoming NIC to be active at a time, which still limits bandwidth to 100 Mbps.

Balance Suite provides functionality similar to NIC Express yet at a higher price. It performed comparably to the latter product, and it also logs NIC failures to the Windows NT event log. But the program lacks both SNMP support and an alert feature. The only way to know whether a NIC has failed is to check the event log manually.

Where you arguably get your money's worth is in Balance Suite's fine graphical monitoring tool, Balance Monitor, which displays real-time traffic flow through each NIC—a feature NIC Express lacks. Separate color-coded bars show the individual protocol on each NIC, and a window at the base of the screen shows each NIC's traffic count and operational status. Moreover, Balance Suite's control panel provides more control than that of NIC Express. (Network Specialists Inc., Hoboken, NJ; 201-656-2121, 800-775-4674; fax, 201-656-2727; www.nsisw.com; *905 at www.pcmag.com/infolink.*)

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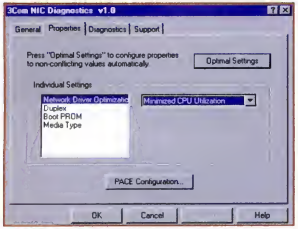
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CONTROL CLUTTER: *3Com's menus include a wide variety of controls to configure the adapters.*

only in Intel's PRO/100 Intelligent adapter. But the 3Com NIC can support only 16 VLAN connections, as opposed to Intel's 64.

Though the card lacks an SNMP agent, 3Com makes managing its NICs simple. In addition to DMI 2.0 support, the company's Self-Healing Drivers attempt to correct common errors without user input, and the resilient server link (RSL) drivers automatically switch to a backup NIC if the primary fails. As with the Intel cards, 3Com's support dynamic code-loading to optimize your NICs to the server's configuration.

The vendor provides the best diagnostic program of the lot. With it, you can thoroughly test a suspect card, review product release notes, check 3Com's BBS and Web page for new drivers, or create an e-mail problem report that you can submit to the company. If all else fails, 3Com provides a lifetime warranty and worldwide technical support.

The Fast EtherLink delivers good features, an unmatched troubleshooting utility, and fine performance. But if you want asymmetric port aggregation, you'll need to wait until 3Com releases its new software.—*LF*

SUMMARY OF FEATURES See **www.pcmag.com** for interactive views

Server NICs

■ YES ▨ NO □ OPTIONAL
Products listed in review order

PC MAGAZINE EDITORS' CHOICE

	Adaptec ANA-69011 Single32 Fast Ethernet NIC	Adaptec ANA-6922 Duo 2-Port Fast Ethernet NIC	Compaq NC3122 Fast Ethernet NIC	Intel PRO/100+ Server Adapter	Intel PRO/100 Intelligent Server Adapter	Matrox 100 Multiport NIC	Matrox 100 Multiport NIC+	3Com Fast EtherLink Server NIC
List/street price	$85 / N/A	$375 / N/A	N/A / $340	$119 / N/A	$399 / N/A	$679 / $550	$1,199 / $960	$199 / $140
General								
Number of ports	1	2	2	1	1	4	4	1
Maximum number of boards per server	8	8	Server limited	Unlimited	Unlimited	4	4	16
Supports 10/100 Mbps	■	■	■	■	■	■	■	■
Autoswitch	■	■	■	■	■	▨	▨	■
32- or 64-bit bus	32-bit	32-bit	32-bit	32-bit	32-bit	32-bit	32-bit	32-bit
On-board CPU	▨	▨	▨	▨	■	▨	■	▨
CPU type	N/A	N/A	N/A	N/A	Intel i960	N/A	Intel i960	N/A
On-board memory	8K	6K	3K	6K	1MB	None	1MB	4K
Included drivers:								
Window NT	■	■	■	■	■	■	■	■
NetWare 3.x	▨	■	■	■	■	■	■	▨
NetWare 4.x	■	■	■	■	■	■	■	■
Other OS support	Windows 95, 98	SCO Unixware	SCO Unixware	Windows 95, SCO Unixware, Sun Solaris	Windows 95, SCO Unixware, Sun Solaris	None	None	None
Ethernet controller chip	Adaptec	DEC	Intel	Intel	Intel	DEC	DEC	3Com
Fault tolerance	■	■	■	■	■	■	■	■
Redundant links	■	■	■	■	■	■	■	■
Administration and Management								
Bandwidth aggregation/load balancing	▨	■	■	■	■	■	■	▨
Third-party software included	▨	▨	■	▨	▨	■	■	▨
Fast EtherChannel	▨	▨	■	■	■	▨	▨	▨
Full-duplex support	■	■	■	■	■	■	■	■
Diagnostics included	▨	■	■	■	■	▨	▨	■
SNMP agent	■	■	■	■	■	■	■	▨
RMON	■	▨	▨	▨	▨	▨	▨	▨
Bus mastering	■	■	■	■	■	■	■	■
MII connector	▨	▨	▨	▨	■	▨	▨	▨
DMI 2.0 support	■	■	■	■	■	▨	▨	■
PCI Hot Plug	▨	▨	■	■	■	▨	▨	▨
VLAN support	▨	▨	□	▨	■	▨	▨	■
Cisco ISL VLAN support	▨	▨	▨	▨	■	▨	▨	▨
ACPI support	■	▨	■	■	▨	▨	▨	▨
Shared hardware interrupt support	■	■	■	■	■	■	■	■

N/A Not applicable—The product does not have this feature.

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— *PC Magazine*, May 1998

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Net Tools
FROM THE BENCH

VIDEOCONFERENCING

Room Full of Faces

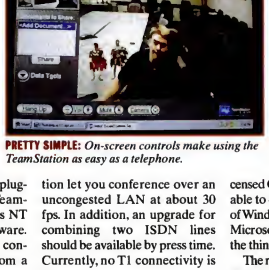
By Ted Needleman

By offering a sub-$10,000 conference-room-level system, Intel hopes to heat up the high-end, multipoint videoconferencing market, long dominated by systems priced in the $15,000 to $20,000 range. Intel touts its TeamStation 4.1 ($9,999 list; with monitor, $11,999) as both an ISDN or LAN videoconferencing system and a fully functional conference-room PC. Though the PC fell a bit short, we found TeamStation generally to be a well-conceived solution, competitive with higher-priced products.

An illustrated poster helped make our setup a snap; most of the effort involved unpacking parts and plugging them in. At start-up, TeamStation brings up Windows NT and the TeamStation software. Our only complaint is that configuration was handled from a separate program, requiring you to shut down the TeamStation software, use the Administration program, and then restart the system.

TeamStation was as simple to use as a telephone. On connecting, a helpful set of bars at the bottom of the screen turned green or red to show the call's status.

Intel's optional TeamStation Manager 1.0 (for 10 seats, $7,999) is a custom version of LANDesk. Manager lets you easily administer TeamStation machines and sessions remotely. According to the Intel diagnostic, we obtained 15-frame-per-second (fps) high-quality video with an ISDN connection. In viewing personnel around a conference table, we were able to see faces and expressions clearly. The bundled NIC card and a TCP/IP connection let you conference over an uncongested LAN at about 30 fps. In addition, an upgrade for combining two ISDN lines should be available by press time. Currently, no T1 connectivity is planned.



PRETTY SIMPLE: *On-screen controls make using the TeamStation as easy as a telephone.*

Housed in a mini-tower case, the system's PC is based on a 333-MHz Pentium II processor with 64MB of SDRAM. Though adequate for most suitable tasks, the system provides only two open PCI slots, a 2.1GB hard disk (though a 4.3GB unit will ship by press time), and a 24X speed CD-ROM drive.

Intel TeamStation 4.1. List price: $9,999; with 29-inch monitor, $11,999. Intel Corp., Hillsboro, OR; 800-538-3373, 408-765-8080; www.intel.com/prosharc/conferencing. *906 at www.pcmag.com/infolink.*

TERMINAL SERVERS

Microsoft Thinks Thin

By David Chernicoff

The most lucrative segment of the multiuser server market is in terminal devices. A single server performs the processing for multiple thin clients, which is ideal for data entry tasks such as inventory and reservations where a standalone PC is overkill. This market has long been dominated by Unix and mainframe vendors, but Microsoft has had an eye on it, too.

Microsoft's biggest obstacle was Windows NT's lack of multiuser support. To overcome this, the company purchased the MultiWin technology that Citrix used in its WinFrame server, which lets multiple clients run Windows applications in terminal sessions.

WinFrame was based, however, on the Windows NT 3.51 code base, and the sweeping architectural changes in Windows NT 4.0 made porting WinFrame a significant task. Instead, Microsoft licensed Citrix's technology and was able to create a multiuser version of Windows NT 4.0, thereby giving Microsoft a strong entry into the thin-client market.

The result is Microsoft Windows NT 4.0 Terminal Server Edition, which brings the Windows interface to shops with terminal workers employing Windows CE–based thin clients. Moreover, Microsoft foresees that Terminal Server will be the foundation for network, Internet, and palmtop thin-client devices using embedded versions of Windows CE.

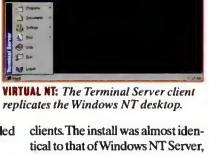
We also tested Citrix's MetaFrame 1.0, which sits on top of Terminal Server and extends its capabilities to non-Windows clients. It supports most OSs and also adds significant capabilities such as support for non-IP networks, load balancing, and additional connection options that provide a more complete solution.

Microsoft Windows NT Terminal Server Edition

Code-named for the mythical, multiheaded Hydra, Microsoft Windows NT 4.0 Terminal Server Edition (with ten client access licenses, $1,129 list) is the company's first multiuser version of Windows NT. Terminal Server brings the functionality of Windows NT 4.0 to terminal sessions and offers trouble-free connectivity with Windows-based clients.

Every Terminal Server client requires a $20 client access license (CAL) and a $230 Windows NT Workstation (NTW) license. Although the version we tested includes ten CALs, it doesn't include the NTWs—raising the total price for ten users to $2,359.

Installation went smoothly, but you need a hefty system to service even just a few clients. Terminal Server requires 32MB of RAM for the OS and 4–12MB for each client, which made our dual-processor server with 160MB of RAM adequate for only ten (or fewer) clients. The install was almost identical to that of Windows NT Server, and we had no trouble with it.



VIRTUAL NT: *The Terminal Server client replicates the Windows NT desktop.*

Terminal Server uses Remote Display Protocol (RDP), a proprietary extension to the T-120 remote-display-and-control protocols. RDP clients replicate a Windows NT GUI, but the client

Net Tools

FROM THE BENCH

machine must be running Windows. Also, RDP works only on TCP/IP networks. To run on non-Windows and/or IP-networks, you'll need to run MetaFrame.

We tested the RDP client on three devices: a Windows NT Workstation, a Windows 95 PC, and a Wyse Winterm 3315SE thin client. The Winterm uses an embedded version of Windows CE, which allowed it to run RDP. Once the clients were connected to the Expressly made to run on top of Terminal Server, MetaFrame also includes support for additional networking protocols, connection options, and load balancing.

Instead of Microsoft's RDP, Citrix uses its own Independent Computing Architecture (ICA) clients, is not limited to TCP/IP connections, as is RDP. MetaFrame lets you use networks that employ IPX/SPX and NetBUI, so if you aren't running an IP network, MetaFrame is your only choice.

Moreover, this product includes a wide variety of network connection options unsupported by Terminal Server. MetaFrame supports direct-dial connections to Terminal Server, as well as multiport serial access. Trading performance for price, serial access lets you connect many clients to the server's serial ports cheaply and obviates the need for additional network hardware or software to route the connections.

If you're planning on using more than 15 thin clients, Citrix offers a useful option not available from Microsoft. WinFrame Load Balance Option Pack ($1,495 list per server) lets MetaFrame distribute the client load across multiple servers.

MetaFrame 1.0. List price: With 15 client licenses, $4,995. Citrix Inc., Fort Lauderdale, FL; 800-437-7503, 954-267-3000; fax, 954-267-9319. www.citrix.com/products/metaframe.asp. *908 at www.pcmag.com/infolink.*

CROSS TALK



Toni Kistner

Well, Frank, we finally see Microsoft's Terminal Server. It's kind of a letdown after all of the hype. You plug it in and it works. Looks as if small businesses could save a few hundred dollars per seat using this approach. Are you still a fan of this technology?



Frank Derfler

Terminal Server's real value is for vertical applications, such as a database server. You can run the database server inside the same PC that's running Terminal Server or connect them with Fast Ethernet. You set an economical and easily managed system.

network, a client dialog box asked us for the server's IP address. After we entered it, we were on our way.

To test performance, we installed Microsoft Office 97 on our Terminal Server. Response time for normal editing tasks on clients was acceptable even with all three clients in simultaneous use, though spell-checking a 30-page document on each slowed performance noticeably. Performance wasn't unacceptably slow, but it does indicate that client activity can affect even a powerful server with a fairly light load.

Microsoft Windows NT 4.0 Terminal Server Edition. List price: $1,129. Microsoft Corp., Redmond, WA; 425-882-8080; www.microsoft.com. *907 at www.pcmag.com/infolink.*

MetaFrame

Though Microsoft has claimed the Windows CE world as its own, MetaFrame 1.0 ($4,995 list with 15 client licenses), from Citrix, brings the capabilities of Microsoft Windows NT 4.0 Terminal Server to non-Windows clients. which lets MetaFrame operate with DOS, Java-based, Mac, and Unix devices as well as older terminal stations. Each ICA client requires a Microsoft NWT and CAL license, however, as well as the Citrix ICA license.

Installation on our server was without incident. Because ICA has no support for Windows CE clients, we used a different version of the Wyse Winterm 2315SE. For testing MetaFrame on non-Windows de-



FLEXIBLE CONNECTIONS: *MetaFrame lets you configure varied connection types.*

vices, we used a Power Macintosh G3 and a Sun Netra Unix Workstation with Solaris. In all cases, the terminal sessions popped up without a hitch and provided an uneventful client session with our server-based application.

MetaFrame also adds significant value in certain network environments. MetaFrame's ICA protocol

NETWORK MANAGEMENT

Slim Management

By Greg Alwang

Administrators often spend more time managing their management software than they do the network. Geneva Software's AlertPage Enterprise 4.1 ($695 list per server), is designed to plug into larger management packages to provide easier and more extensive reporting on network services such as FTP or Web servers. AlertPage includes exhaustive reporting and alerting options, plus extensive SNMP support for easy connectivity with network management packages such as HP OpenView.

AlertPage was extremely easy to install. On loading the software onto a Windows NT client PC, we immediately began receiving data on network devices from the Discovery option. Extensive filtering options let you tailor alert notifications for network faults by specific device and select a notification method—for example, via e-mail or pager. AlertPage also translates cryptic error messages into plain-English alarms, a feature often seen only in high-end management tools.

This product automatically discovers all active Windows NT services, auto-detects new devices, and even restarts failed Windows services remotely. AlertPage can monitor multiple NetWare NDS trees and test NetWare and Windows NT log-ons and authentications. Perhaps its best feature is the reporting engine, Network



IN THE RED: *Executive-level reports show basic information graphically.*

Report Card (NRC), which lets you group services, devices, and applications by business function.

Notable features in the new version include a Profile Wizard for building reports and enhanced SNMP support for integration with large-scale management products. In addition to a database with over 6,000 SNMP traps, there's an Event-to-Trap translator that converts non-SNMP alarms and events into SNMP traps usable by the larger packages.

AlertPage Enterprise 4.1. List price: $695 per server or SNMP device. Geneva Software, Northbrook, IL; 800-315-0952, 847-562-0012. www.genevasoft.com. *909 at www.pcmag.com/infolink.*

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ScanMaker 4

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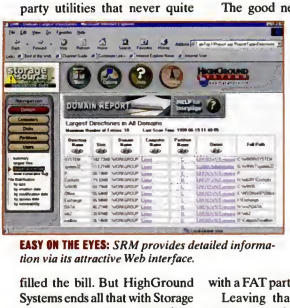
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Mastering Disk Management

By Warren Ernst

Until now, managing your networked disk resources on Windows NT has been a tedious, multistep process. Often, you had to resort to a mishmash of Windows NT tools and third-party utilities that never quite monitor client use of shared resources. SRM also requires five components from Microsoft's Internet Service Manager, a host of modules within Data Access Components 1.5, and other Microsoft Windows NT components.

The good news is that SRM goes a long way to make this onerous setup manageable. The installation disk scanned our server prior to the install, then listed the components that we needed. Nevertheless, our setup required a call to tech support; it turned out we needed a patch for using SRM with a FAT partition.



EASY ON THE EYES: *SRM provides detailed information via its attractive Web interface.*

filled the bill. But HighGround Systems ends all that with Storage Resource Manager or SRM ($495 list). This program provides a flexible automated quota and disk-space monitoring system for servers that's easy to administer from a single Web interface.

Setting up the program requires considerable time and effort, though. You'll need a server with 64MB of RAM running Windows NT 4.0 with Service Pack 3 and Microsoft Internet Information Server (IIS) 4.0. To enable polling and reporting to the central management console, you'll need to install an agent manually on each Windows NT client to

Leaving that behind us, we were better able to appreciate the program. SRM is elegant and intuitive to use; from a browser, we could view free space on drives and which users owned the largest files. SRM's charts contain plenty of hypertext links that make it easy to drill down for details.

Storage Resource Manager. List price: Single-server edition, $495; network edition, $995 ($399 per Windows NT Server, $49 per Windows NT Workstation). HighGround Systems, Marlborough, MA; 508-460-5152; www.highground.com. *910 at www.pcmag.com/infolink.*

Show Me the E-Money

By John Garris

E-commerce development means different things to different people. Web storefronts need to engage the customer and require mechanisms that provide personalization, site analysis, and online payment processing. Business-to-business sites require standards-based data-transfer formats, good security, and integration with existing systems. The point is that one size definitely does *not* fit all.

Net Tools

FROM THE BENCH

Domino.Merchant 2.0 Server Pack and Microsoft Site Server 3.0 Commerce Edition both offer everything you need to build an e-commerce site. Site Server includes a wealth of integrated tools for site analysis, site-wide search, and ad serving. Lotus bases Domino.Merchant on its Domino databases (as seen in LotusNotes) and a thorough setup wizard to do all the site creation.

Though both provide templates and wizards for building starter sites, you will also need to tailor your site to grow with you—by commiting to the development platform your product uses. Site Server lets you customize pages via Active Server Pages (ASP) and Component Object Model (COM) component development.

Domino.Merchant provides limited customization options using wizards and predefined content-creation tools. Although the Domino architecture allows for complex Web development through Lotus-Script (Domino's macro language) and Java, they require a separate purchase.

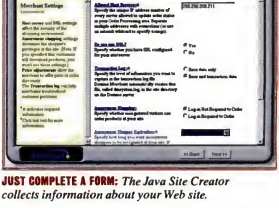
In the final analysis, Site Server gives you more options than Domino.Merchant. Though the latter product can meet the needs of small companies with simple business requirements, Site Server provides the more comprehensive and versatile platform.

Domino.Merchant Server Pack

Lotus is pitching its Domino .Merchant 2.0 Server Pack ($3,495 list) at small, non-Domino shops that want to set up a commerce-enabled Web site. The massive scope and complexity of the Domino environment, however, makes this a tall order; we found this product better suited to shops with the know-how and tools to exploit Domino's strengths.

All data, including Web sites, is stored in Domino-proprietary databases. Domino.Merchant provides a Site Creator wizard that asks dozens of questions about every aspect of page design, from SSL security to Web layout, and then uses the answers to build your site.

On our Pentium 166 with 128MB of RAM, the process of compiling the Domino databases took over 90 minutes. We found the resulting frames-based site easy to navigate and visually appealing. Yet sometimes, it didn't update certain frames properly, forcing us to exit and reenter the site. Also, we were disappointed



JUST COMPLETE A FORM: *The Java Site Creator collects information about your Web site.*

with Site Creator's lack of flexibility. For example, it asked us to choose from limiting either/or-type options, such as whether our products were available via download or required shipping.

Domino's databases provide security superior to Site Server's. The server maintains a list of users who have various access levels, and users with the appropriate access can log on and make changes. Also, Domino leverages its document management capabilities by letting administrators set up workflow-based approval mechanisms that

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- **E-mail** + contact name opens and addresses a new e-mail form.
- **Fax** creates and addresses a new fax form. (Requires bFax Express).
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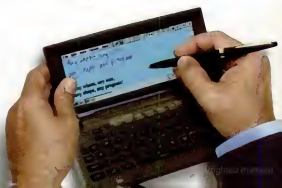
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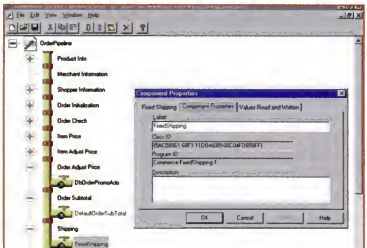
can do things such as ensure that content is approved prior to posting.

Unlike Site Server, Domino.Merchant's third-party-tools integration is limited. Although the product lets you import single HTML files into a Domino database, the process is fairly cumbersome and time-consuming and won't work with standard Web-authoring tools—as it does with Site Server. If you want to do any extensive customization, you'll need to use the full Domino development client, Notes Designer for Domino, which costs an additional $495.

Domino.Merchant 2.0 Server Pack. List price: $3,495. Lotus Development Corp., Cambridge, MA; 617-577-8500; www.lotus.com. *911 at www.pcmag.com/infolink.*

Microsoft Site Server Commerce Edition

A special-purpose version of Site Server Standard Edition, Microsoft Site Server 3.0 Commerce Edition ($3,499 list) is a fine set of interrelated products that rely on a combination of Active Server Pages (ASP) scripts, custom-built COM components, and third-party components to build and grow your site.



FLOWCHART: *The Pipeline editing feature shows all the COM components involved in an order-processing phase.*

Commerce Edition provides wizards to ease building your site foundation. Specify a number of Windows NT configuration options (such as the required ODBC data sources) and input specific site details, and the wizards generate the Web pages for the starter site and the administration site—as well as a set of database-schema files that it loads into your ODBC-compliant database. We found that this process was much faster with Site Server than with Domino.Merchant.

You make updates to your site through the Microsoft Management Console (MMC). And unlike Domino.Merchant, it lets you use standard HTML editors on your pages. The MMC also lets you add new products and departments (or categories) to your product list and view all processed orders and shoppers on your site, as well as define cross-selling mechanisms.

Site Server's unique software Pipeline streamlines order processing. Pipeline is a set of tasks that define the process—such as validating a credit-card number, approving payment, modifying inventory, and creating a purchase order. Its tasks correspond to a set of COM components. Third-party vendors and developers can build their own components, and in-house developers can extend their sites by writing components that perform legacy integration. Unlike Lotus, Microsoft includes an Ad Server in the package that lets you track ad hits and process ad requests.

Because Site Server is built specifically on Microsoft's model of ASP and COM development, you'll have to commit your site to the Windows NT platform. But if you're willing to forsake other platforms, Site Server is the definitive choice.

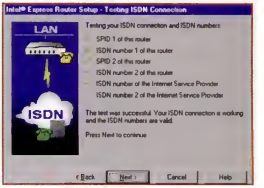
Microsoft Site Server 3.0 Commerce Edition. List price: $3,499 per server, plus $2,995 (unlimited Internet client license) or $49.95 per individual client. Microsoft Corp., Redmond, WA; 425-936-8080; www.microsoft.com. *907 at www.pcmag.com/infolink.*

ISDN ROUTERS

The Amazing Tunneling Router

By Les Freed

Targeted at the branch office, the Intel Express 8100 Router ($599 list) provides two functions that such users need most. These are an ISDN router for sharing an Internet connection and Virtual Private Network (VPN) capability, a low-cost way to connect to the corporate WAN via the Internet.



HANDS-OFF SETUP: *As the setup wizard completes each step, it adds a green check mark.*

The Express 8100 is a gray, cigar-box–size unit with seven status LEDs on the front and 10/100-Mbps auto-sensing Ethernet and ISDN U interface connectors on the back. One of the first small routers we've seen to include a dual-speed Ethernet port, it supports Network Address Translation (NAT), which lets connected PCs access the Internet using a single IP address. The Express 8100 lacks an analog phone port, however.

An installation wizard walks you through one of three canned scenarios: remote LAN access, Internet Access via an ISP, or VPN connection via an ISP with optional Internet Access. Each attempts to auto-detect switch type and SPID information, and after you configure the line, the wizard places test calls to check your connection.

Once the Express 8100 is running, the Device View software eases the task of configuring and monitoring the unit. The router also has a rear button that resets the Express 8100 to the factory configuration, a feature we liked and thankfully found impossible to hit by accident.

A VPN uses strong data encryption and IP tunneling to create a secure Internet connection for private data. Because the Express 8100 uses an Intel-proprietary tunneling protocol, you'll need one of these units on either side of the connection. We tested only its routing capabilities. The 140-bit encrypted connection can pass through any network protocol, but the routers each must have a fixed IP address. When used as just a router, the Express 8100 can use a dynamically assigned IP address.

Intel Express 8100 Router. List price: $599. Intel Corp., Hillsboro, OR; 800-538-3373, 308-264-7354; www.intel.com. *906 at www.pcmag.com/infolink.*

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PC Tech



ILLUSTRATION BY CARY HENNE

The 1998 *PC Magazine* Shareware Awards

We showcase our twelve top picks and present overall favorite ICQ, the Internet chat phenomenon from Mirabilis.

By Sheryl Canter

The Internet is a natural distribution mechanism for shareware, and with the spectacular growth of the Internet, the shareware industry is booming. In this year's fifth annual Ziff-Davis Shareware Awards contest, editors from ZDNet sifted through nearly 14,000 entries—more than double that of last year. The 114 finalists were sorted into 23 different categories, and then assigned to 3 Ziff-Davis magazines for final judging. *PC Magazine* judged 12 categories, *Family PC* judged 7, and Computer Gaming World judged 4. Winners were announced on July 16, 1998, at the Shareware Industry Convention in Warwick, Rhode Island.

The Ziff-Davis Shareware Awards contest honors the best PC-based shareware products released or significantly upgraded in the last year. All programs available from the ZDNet Software Library (*www.hotfiles.com*) that met this criteria were automatically entered into the competition. The cut-off date for uploading new entries was 6:00 A.M. EDT on April 6, 1998.

The 60 finalists and 12 category winners in the *PC Magazine* contest are listed in the sidebar "*PC Magazine* Finalists." Download links for the finalists are available from PC Magazine Online; the Web version is at *www.pcmag.com/pctech/download/awards.html*. On CompuServe, you can type GO ZNT: CENTER. The pages that follow describe each of the 12 category winners. The overall winner this year is ICQ, an Internet chat program from Mirabilis that has acquired over 11 million registrations (6 million of which are active) in less than 2 years.

www.pcmag.com/pctech

You'll find all of the articles, examples, and code files in this section at PC Tech Online.

INSIDE

TUTOR: The new PC 98 System Design Guide provides specifications for required and recommended features for a wide variety of PC types. The idea is to make sure you're getting the hardware you need when you buy a new system. *Page 239.*

OPERATING SYSTEMS: The best system is a well-maintained system, and Windows 98's Maintenance Wizard can help you keep yours functioning at its peak. We take a look at its tools and the System Configuration Utility. *Page 245.*



POWER PROGRAMMING: Visual Basic can call almost any Windows API function and thus make use of almost any Windows feature. But the support isn't always built in, as in our example—changing screen resolution from a VB program. *Page 251.*



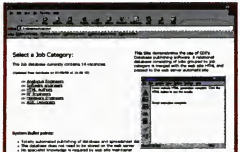


PC SOLUTIONS: Managing toolbars in Windows 98; using Rundll32.exe to format disks; an alternative to a bootable SCSI adapter; a disappearing toolbar in IE3's Mail module; creating an acronym list in Word; transposing Excel ranges; DOS-style printing in FoxPro for Windows. *Page 259.*

WEB DEVELOPMENT

GDIdb

The winner in the Web Development category is GDIdb, a tool for publishing ODBC-compatible databases and spreadsheets on the Web. It works by executing a script file that describes how to translate the data source into a series of HTML documents. A Script Wizard lets you create scripts without having to learn the GDIdb script language. To obtain total control over the appearance and structure of the generated HTML pages, you can edit the script file manually.



GDIDB *uses scripts to generate html representations of databases.*

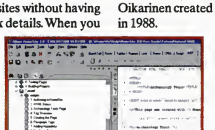
If you connect to the Internet through a dial-up or ISDN connection, you can use GDIdb's built-in FTP facility to copy the generated HTML documents to your Web server. An option lets you upload only those files that have changed—which is useful if your database is large.

GDIdb does not create a live database on the Web server; it's a static page generator. But updating is easy since the entire process can be automated and executed on a schedule. The program can also be run from the command line, for use with external schedulers and scripts. GDIdb offers a painless, low-cost way to publish databases for Web access. **GDIdb, v3.1.0.** List price: $38. Global Data Industries, Swindon, Wiltshire, UK; +44 1793-484990; *www.gd-ind.com.*

HTML EDITORS

HomeSite

HomeSite 3.0.1 is the winner in the HTML Editor category. This code-based tool lets you create sophisticated Web sites without having to memorize HTML syntax details. When you type an HTML tag in the edit window, a number of options appear in a pop-up list. Select the one you want, and HomeSite will insert the syntax for that option. A customizable tag toolbar will automatically insert opening and closing tags with a mouse click. Tag editors let you select options from a dialog box, and wizards make quick work of frames, tables, pop-up windows, tables of contents, and other advanced features.



HOMESITE'S *thorough tutorial walks you through all the program's features.*

HomeSite features a highly customizable, two-pane interface. On the left, it displays lists of files, HTML tags, and reusable code snippets. On the right is an edit window with tabs for each open file. You can toggle between the edit window and a preview window with a single keystroke or mouse click.

A Project Manager lets you group together the different files that make up your Web site. You can perform search-and-replace operations across all the files in a project, and you can verify a project's hyperlinks. HomeSite is a beautifully designed program that deserves its fame as one of the best HTML editors on the market.

HomeSite 3.0.1. List price: $79. Allaire Corp., Cambridge, MA; 888-939-2545; *www.allaire.com/products/homesite.*

E-MAIL, NEWS READERS, CHAT

ICQ

The winner in the E-Mail, News Readers, Chat category—and the overall winner of *PC Magazine*'s Shareware Awards contest—is ICQ from Mirabilis, an instant messaging utility. There is something about being on a computer network, invisibly connected to hundreds, thousands, or millions of people, that makes people want to chat. Even the earliest network operating systems had instant messaging capabilities, and instant messaging has been popular on the Internet since Jarkko Oikarinen created IRC (Internet Relay Chat) in 1988.

Feature-rich and user-friendly, ICQ (I Seek You) was introduced by Mirabilis in November 1996 and quickly became the tool of choice for real-time communication on the Internet. ICQ informs you when friends or coworkers log on to the Internet so you can initiate a real-time chat session. Unlike any other instant messaging product, you can see what other people type before they press the Enter key. You see them pausing to find the right word and backspacing to correct typos. To add further personality to your messages, you can change the foreground and background colors, and the size, type, and color of your font.

If no one you know is currently online and you still feel like chatting, you can search for random users in one of several groups: General Chat, Romance, Games, Students, and various age groups. Users choose which group to belong to and specify whether they are available for random chats. You can participate in group chats by adding the chat room of your choice to your ICQ contact list. Users can create new chat rooms, and there are a huge number of them. In addition to chat, ICQ can notify you when you receive e-mail, let you hide from people you don't want to talk to, access voice communication and group gaming software, and much more.



ICQ *informs you when a person on your contact list logs on to the Internet.*

ICQ handles communication through a server that stores the participants' registration information. Within six months of its introduction, ICQ received 850,000 registrations. Today it has more than 11 million registrations, of which 6 million are active. The rapid growth has meant an overloaded server at times, but the company struggles to keep up. **ICQ, Beta (DLL 1.30).** List price: Free during beta period. Mirabilis Ltd., Tel-Aviv, Israel; +972-3-6488090; *www.mirabilis.com/icqhomepage.html.*

DESKTOP ACCESSORIES

Judy's TenKey

The winner for Desktop Accessories is Judy's TenKey, a high-powered calculator that features a history tape, selectable calculator syntax, and built-in financial and statistical calculations. The customizable display lets you hide the features you don't need—for example, the number pad or trigonometry functions.

The history tape records your calculations in a scrolling list, which you can save to disk. If the ten built-in memory locations are not



JUDY'S TENKEY *lets you select the calculator syntax.*

enough, you can use the tape for additional memory; right-click on a tape number to reuse it. The right-click menu also lets you modify a number you entered and have the tape recalculate. The number of lines displayed on the tape and the font used for numbers and notes are all customizable. You can also hide the tape completely.

Judy's TenKey does not lock you into a calculator syntax. You can switch between calculator-style, adding machine-style, and Reverse Polish Notation.

If these styles are unfamiliar to you, consult the online Help file for detailed instructions. As an all-purpose calculator that doesn't overwhelm you with features, this is one of the very best.

Judy's TenKey, v4.0. List price: $19.95. Judy's Applications, Santa Clara, CA; 800-242-4775; *www.judysapps.com.*

APPLICATIONS

NoteTab Pro

NoteTab Pro, the winner in the Applications category, is a plain-text and HTML editor that does math on the side. It can handle files up to 16MB in size, and recognizes DOS, Unix, and Macintosh text. A filter lets you choose between the ASCII character set used by DOS and the ANSI character set used by Windows.

The highly configurable user interface features a customizable toolbar, and a tab bar for switching between documents. You can perform search-and-replace operations across all open documents. A special outline format lets you jump instantly to key sections in a document. You can also embed hyperlinks in documents.

One of the product's most useful features is the Clipbook, which is a collection of pastable text snippets, each associated with header text. You can paste any item in the Clipbook by selecting or typing the header. Clipbooks also support a syntax that lets you open URLs, execute programs, or send e-mail. Clipbooks have many uses, and the program comes with some prebuilt Clipbook Libraries. For example, there is an HTML library that can insert tags into an HTML document.



THIS HIGHLY *configurable text editor also does math.*

Other NoteTab Pro features include a spell-checker and thesaurus, multiple undo/redo, and the ability to calculate mathematical expressions embedded in text. NoteTab Pro provides a lot of editor for very little money.

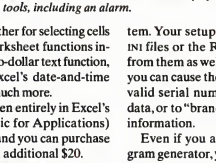
NoteTab Pro, v4.011. List price: $9.95. Eric G. V. Fookes, Geneva, Switzerland; *Fookes@sc2a.unige.ch; www.notetab.ch.*

APPLICATIONS

Power Utility Pak 97

Power Utility Pak 97 (PUP97) is a set of extensions to Microsoft Excel 97. (An earlier version is still available for Excel 5 and Excel 95.) The program includes 31 utilities, 40 custom worksheet functions, 3 games, and some optional shortcut menu enhancements. A large number of the utilities, most of the functions, and all of the games are disabled in the unregistered version of the program.

The utilities are divided into eight categories: Range, Formatting, Worksheet, Workbook, Printing, Date & Time, Chart, and Object. A text tool lets you change case or modify text in a specified range. With the cell-lock utility, you can apply locks in a single operation to all cells meeting stated criteria (for example, all cells with formulas). Another tool lets you add bookmarks to spreadsheets. PUP97 includes an alarm utility that can help you get to meetings and appointments on time. There's a tool for batch printing, and another for selecting cells by value. The worksheet functions include a number-to-dollar text function, extensions to Excel's date-and-time repertoire, and much more.



PUP97 *enhances Excel 97 with a variety of tools, including an alarm.*

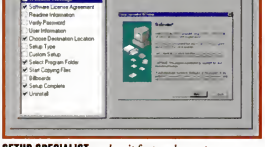
PUP97 is written entirely in Excel's VBA (Visual Basic for Applications) script language, and you can purchase the source for an additional $20.

Power Utility Pak 97, v3.0b. List price: $39.95; with source code, $59.95. JWalk & Associates, La Jolla, CA; *www.j-walk.com/ss/pup/pup97.htm.*

PROGRAMMING TOOLS

Setup Specialist 97b

The champion in the Programming Tools category is Setup Specialist 97b. This full-featured install program generator rivals—and in some areas surpasses—commercial products costing hundreds of dollars more. And Setup Specialist is exceedingly easy to use. A built-in set of training cards walks you through the process of creating an installation program. You check off options to include any or all of 13 user interface pages, from simple Welcome and Readme pages to a Custom Setup page to a user information page that can record serial number and registration code data. You also can specify any applicable hardware and software requirements right in the install program.



SETUP SPECIALIST *makes it fast and easy to create sophisticated installation utilities for your programs.*

Setup Specialist provides all of the expected features, including support for uninstallation, automatic registration for OCXs and OLE-based DLLs, and access to variables defining important directories on the target system. Your setup programs can add data to INI files or the Registry, and can read data from them as well. By creating a simple DLL, you can cause the install program to require valid serial number and registration code data, or to "brand" the executable with user information.

Even if you already own an install program generator, you should evaluate this excellent product. You may switch!

Setup Specialist 97b, v1.56. List price: $89. TG Byte Software, Bensheim, Germany; *info@setupspecialist.com; www.setupspecialist.com.*

GRAPHICS AND MULTIMEDIA

Screen Saver Toolkit

Screen Saver Toolkit, the winner in the Graphics and Multimedia category, lets you create professional, Windows-compatible screen savers that you can distribute royalty-free. A wizard-style interface walks you through the process. Each screen concentrates on a particular task, such as collecting images, sequencing images, adding sounds, and choosing transition effects.

The first step is to create a screen-saver project. You can choose between two types of screen savers: slide show or presentation-style. Slide show screen savers display images in random sequence, whereas presentation-style screen savers display them in a specified order. The program supports three image file types: BMP, BMZ (LZW-compressed BMPs), and JPEG. You also can incorporate sounds and AVI movies.

Once you've created the project, you can build the screen saver for distribution. A Wizard helps you create a setup program that can include a license agreement, Read.me file, or advertising banner. You even can insert an expiration date, or use push technology to download a new version of your screen saver whenever you have new content. Stardust's Screen Saver

PC Magazine Finalists: 1998 Ziff-Davis Shareware Awards

Listed below are the 60 finalists in the 12 categories judged by PC Magazine. The winner in each category appears in bold type. Descriptions and download links for all the finalists are available from PC Magazine Online. On the Web go to *www.pcmag.com/pctech/download/awards.html*.

APPLICATIONS	
As-Easy-As	Trius Inc.
Gator Edit	Dangerous Cybernatics
NoteTab Pro	**Eric G. V. Fookes**
UCalc	Daniel Corbier
UnitStar	Tao Yue
BUSINESS	
Adarus Business Plan	Adarus Software
Atrex32	Millenium Software
Expense Report 98	Zoom Systems
Power Utility Pak 97	**JWalk & Associates**
SyTools 32	AnverySoft
COMMUNICATIONS AND NETWORKING	
CU-SeeMe	White Pine Software Inc.
OmniHTTPd	Omnicron Technologies Corp.
NT Command Line Security Utilities	Keith Woodard
WinProxy	**Osiris Software**
WinTel32	SMSoft
DESKTOP ACCESSORIES	
Aboriginal Art Screen Sever	Image Factory Software
DieLog32	Wolfgang John
GeoClock	J. H. Algren
Judy's TenKey	**Judy's Applications**
LaserUpl Simple Calculator	LaserUpl Software
E-MAIL, NEWS READERS, CHAT	
Gravity 2.0	MicroPlanet Inc.
ICQ	**Mirabilis**
NewsBin	SWAT Consulting
NewsMonger	TechSmith Corp.
Spam Exterminator	Uniayn Software LLC
FILE UTILITIES	
Drag and View	Canyon Software
TidyDisk	American Systems
Turbo Browser 98	**Pacific Gold Coast Corp.**
TurboZip 97	Pacific Gold Coast Corp.
WinZip	Nico Mak Computing
GRAPHICS AND MULTIMEDIA	
ACDSee	ACD Systems Inc.
Jet Audio	Cowon Systems Inc.
MyFonts	UniTech/MyTools.com
Screen Saver Toolkit	**Stardust Software**
Symmetrica	Software Engineering Inc.
HTML EDITORS	
Alchemica Webworks	Alchemica Webworks
CoolCat	**Anawave Software**
HomeSite	**Allaire Corp.**
WebEdit PRO	Luckman Interactive Inc.
WebScripter	Code Generation
INTERNET UTILITIES	
Copernic	Agents Technologies Corp.
FlexSite 32	Lincoln Beach Software
Opera	Opera Software
WebFerret	FerretSoft
WS_FTP	**Ipswitch Inc.**
PROGRAMMING TOOLS	
ActiveState Perl	ActivaState Tool Corp.
4NT	**JP Software Inc.**
Java Park	MeWeb Software
Setup Specialist	**TG Byte Software**
Windows Help Designer	Nick Ameladiotis
SYSTEM UTILITIES	
CD-Quick Cache	Circuit Systama
EZ Macroa	American Systems
RagRapalr	Easy Desk Software
SmartBoard	Oakley Data Services
Take Command/32	**JP Software Inc.**
WEB DEVELOPMENT	
Cool Button Tool	Formula Software
@Dldb	**Global Data Industries**
Net-It Now!	Net-It Software Corp.
RiadaCartal	Riada International
Swami	Sausage Software

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SCREEN SAVER TOOLKIT *lets you preview images.*

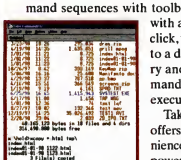
Toolkit offers professional-level features in a package that's friendly enough for neophytes. **Screen Saver Toolkit, v2.1.** List price: $249. Stardust Software, Redmond, WA; 800-300-6943; *www.stardustsoftware.com/sstoolkit.*

SYSTEM UTILITIES

Take Command/32

The winner in the System Utilities category is Take Command/32, a 32-bit Windows version of the company's popular command processor replacement, 4DOS. Take Command includes all the features of 4DOS plus some graphical extras such as a scrollback buffer, a customizable toolbar, and access to common commands through pull-down menus. A "Caveman" feature lets you run character-mode applications with scrolling output (for example, PKZip or XCOPY) directly within the Take Command window.

Small touches like color coding by file type make it easier to read a directory listing. New with Version 3 is the ability to launch a program by typing an associated document name on the command line. Aliases let you create new commands that correspond to sequences of several commands. You can also associate short command sequences with toolbar buttons. So with a single button click, you can switch to a default directory and enter a command for program execution.



TAKECOMMAND *displays output from console apps.*

Take Command offers many conveniences, but its most powerful tool is its batch language. You can obtain information about the system; manipulate strings, numbers, and dates; interact with the clipboard; and much more. This latest version includes a batch-file debugger that lets you single-step through a batch file line-by-line. Like 4DOS before it, Take Command is a must-have for power users.

Take Command/32, v3.01. List price: $69.95. JP Software Inc., East Arlington, MA; 800-368-8777; *www.jpsoft.com.*

FILE UTILITIES

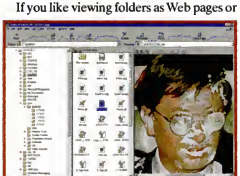
Turbo Browser 98

This impressive file management program mirrors virtually all the features of Windows Explorer and adds many more. It has a tree view of folders and a list view of files, but you can arrange these floating, docking panels any way you wish. A search bar lets you quickly find files by file type, and you can print out file lists.

Turbo Browser supports many file formats. Click on any file and a powerful preview feature will display its contents. You can view multiple preview windows at once, and you can print files from within the preview window.

The unique QBar lets you queue files for viewing, printing, graphics conversion, zipping, or export. For example, you can drag files from various locations on disk to the ExportQ button, then click the button to copy them to a new location. You can copy or move file lists from one QButton to another, and you can even define new QButtons.

If you like viewing folders as Web pages or using the new Thumbnail view, stick with Windows Explorer. But if you use your Windows shell as a tool to locate and launch programs, Turbo Browser 98 will serve you better.



TURBO BROWSER'S *built-in viewer recognizes a multitude of formats.*

Turbo Browser 98, v6.01. List price: $59.95. Pacific Gold Coast Corp., Glen Cove, NY; 800-732-3002; *www.turbozip.com.*

COMMUNICATIONS AND NETWORKING

WinProxy

WinProxy is a secure firewall proxy server for Windows 95 and Windows NT. It hides your PC from outsiders on the Internet. Networked PCs can use WinProxy to share one Internet connection. DNS and HTTP caching reduce access time to frequently visited sites, even when many people are sharing a single, physical connection.

WinProxy supports numerous protocols, including HTTP, NNTP, FTP, DNS, telnet, POP3, IMAP4, RealAudio, America Online, and Socks 4 and 5. This broad support makes access through the firewall transparent, as though your PC were directly connected to the Internet.

Security features let you prevent or restrict access to the Internet based on an IP address. For each IP address, you can specify permitted protocols and enter a unique mail server. Logging features let you monitor access.



THE MAIN WINDOW *shows all connections to the server.*

WinProxy takes just minutes to set up and is especially useful for sharing dial-up or ISDN Internet connections across small networks.

WinProxy, v2.1. List price: Unlimited connections, $299; three connections, $49. Ositis Software, Pleasanton, CA; 510-734-1900; *www.ositis.com.*

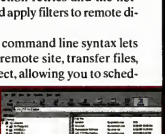
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WS_FTP Pro, v5.00T 98.04.09. List price: $37.50. Ipswitch Inc., Lexington, MA; 800-793-4825; *www.ipswitch.com.*



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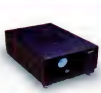
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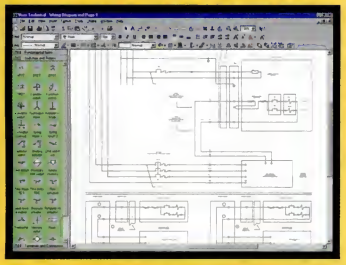
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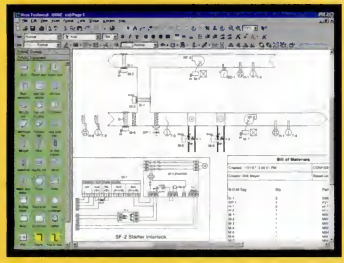
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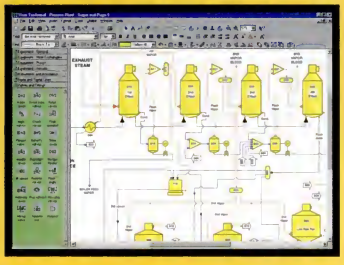
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PC 98: More Powerful and Friendlier Hardware

Microsoft and Intel's new design guide for PC system hardware ups the multimedia ante.

By Neil Randall

From the standpoint of system capabilities and hardware requirements, DOS was a fairly undemanding platform. Certain programs required add-ons, but for text-based programs like early versions of WordPerfect, Lotus 1-2-3, or dBase, a relatively bare-bones system was fine. Then came Windows 3.0, and the world changed. Suddenly, computers needed more memory, more powerful graphics capabilities, better sound and music hardware, and, in general, more support for more devices.

In 1990, a consortium of hardware and software companies calling itself the Multimedia PC Marketing Council released a set of guidelines for PC manufacturers to follow in designing and building PCs. Those whose systems satisfied the specifications were allowed to place the MPC logo on their machines as an indication to consumers that the machines would let them run multimedia-based products designed for Windows. The guidelines became known as the Level 1 MPC (multimedia PC) specifications and were followed in 1993 by the Level 2 MPC specs.

In the computer world, of course, 1993 is ages ago, and a great deal has happened to the PC since then. Multimedia demands are much higher, programs require more powerful hardware than ever, and new devices need special resources. Users expect their computers to do far more than ever before, right out of the box, and they want to be able to add equipment and resources to their machines effortlessly. That's a tall order, given the huge range of equipment available to the PC buyer.

THE PC 98 SYSTEM DESIGN GUIDE

Microsoft and Intel (with input from other companies) have teamed up to produce guidelines called the PC *xx* specifications (*xx* represents the year to which they apply). *The PC 97 Hardware Design Guide* was released in 1996, and early this year the two companies coauthored the *PC 98 System Design Guide*, with Compaq and others chipping in. This guide, combined with the first drafts of the PC 99 specifications, gives you a good sense of what kind of system you'll need to keep up with the newest trends in software and hardware.

These guidelines are the basis of testing by Windows Hardware Quality Labs (WHQL), and hardware that passes testing by this organization can be labeled with the "Designed for Microsoft Windows" logo. The guidelines describe some features as required and others as recommended. To be eligible for the logo, a machine must support all required features. Any recommended feature a manufacturer chooses to include must meet the requirements defined in the guide.

The PC 98 specifications are available for download from the Web at *www.microsoft.com/hwdev/pc98.htm*. The PC 99 guidelines, currently in draft format, are accessible through *http://developer.intel.com/design/desguide*.

The PC 98 design guide differentiates among several types of PCs, according to how the systems are intended to be used. The main systems are the Consumer PC 98, the Office PC 98, and the Entertainment PC 98 (see Figure 1 for special requirements and recommendations for these classes). We'll examine them here, in addition to the Workstation PC 98. The design guide also includes the Mobile PC 98, but we won't have time to look at that here.

PHYSICAL DESIGN

PC 98 stipulates several requirements and recommendations for the physical design of a system. One aspect concerns audible sound produced by a machine. PC 98 requires a machine to be virtually silent when in sleep mode (see the ACPI and OnNow initiatives, described below). The guidelines also encourage manufacturers to limit fan noise as much as possible relative to the size of the system box.

Accessibility is another topic addressed by the guidelines. An entire appendix of the design guide is devoted to making systems accessible to people with disabilities—specifically visual, auditory, and cognitive, along with speech impairments and seizure disorders. The accessibility of internal components is also covered. Happily, all expansion slots must be accessible to users, although manufacturers can configure the physical space inside the box to allow half-

DIFFERENCES AMONG PC 98 SYSTEMS

Feature	CONSUMER PC 98 Required	Recommended	OFFICE PC 98 Required	Recommended	ENTERTAINMENT PC 98 Required	Recommended
System Bus	USB, PCI, no ISA devices	IEEE 1394 port	USB, PCI, no ISA devices	IEEE 1394 port	No ISA, 2 easily accessible USB ports and 2 IEEE 1394 ports (one easily accessible)	Device bay
Graphics	Hardware for 2-D acceleration, 3-D driver support	Hardware for 3-D acceleration, AGP	3-D acceleration driver support	Hardware for 2-D and 3-D acceleration, AGP	Hardware for 2-D and 3-D acceleration, AGP	Large-screen monitor
Video	Basic PC 98 minimum	TV tuner, TV output	Basic PC 98 minimum	DVD-Video and MPEG-2 playback, TV tuner, TV output, video port	DVD-Video and MPEG-2 playback, video input, video capture, TV tuner	TV output, digital or satellite TV tuner
Audio	None	PC 98 audio, music synthesis support	None	PC 98 audio	PC 98 audio, support for 3-D audio and music synthesis	Digital ready
Communications	Internal 33.6-Kbps V.34 modem	High-speed dial-up device using NDIS 5.0 specs	Network adapter with NDIS 5.0 driver	Internal 33.6-Kbps V.34 modem or other high-speed dial-up device	Internal PCM modem	High-speed dial-up device with NDIS 5.0 specs
Storage	8X CD-ROM	DVD-ROM with DVD-Video playback	Basic PC 98 minimum	8X CD-ROM	DVD-ROM drive with DVD-Video playback	External IDE drives use IEEE 1394 port
I/O Devices	Basic PC 98 minimum	USB game pad, remote-control device	Basic PC 98 minimum	Use of external buses for devices	Game controller, all devices HID compliant and connected via external bus	Remote control

height cards and other physical oddities. The PC 98 spec recommends that manufacturers prevent users from gaining access to the system components, thus precluding end-user upgrades of the CPU, RAM, or the motherboard. This is a recommendation for both office and consumer PCs, but preventing upgrade access in a consumer machine might be a bad design decision all around.

The PC 98 specs call for all systems to have specific I/O capabilities. All systems require a keyboard (rather unsurprisingly), connectable to the machine via a PS/2 port or a USB (Universal Serial Bus) port. USB is recommended for consumer and office PCs; a USB or wireless keyboard connection is required with entertainment PCs. A pointing device is also mandatory, and a serial port is not an acceptable mouse port for PC 98 machines. Infrared Data Association (IrDA) wireless capabilities are recommended for all PC 98 machines but are not required in any.

HARDWARE AND POWER MANAGEMENT

As you might expect, the PC 98 specs set minimum hardware requirements. The processor must be at least a 200-MHz Pentium with MMX or an equivalent, and the system must have 32MB of RAM, with 64MB recommended. Furthermore, no more than 4MB of that RAM can be inaccessible to the OS, even if a peripheral requests more. Finally, a 256K Level 2 cache is required.

Power management is covered in considerable detail. All PC 98 motherboards must include support for the Advanced Configuration and Power Interface Specification (ACPI) 1.0. That support is considered so important that the specs prohibit the system's CMOS from providing facilities for disabling it. For compliance with ACPI, both a power button and a sleep button are recommended, and one or the other is required. PC 98 also requires an alarm that will wake the PC at a specific time and on a specific day of the month. The system must support the S5 sleep state as well as one of the S1, S2, or S3 states, and the USB controller must be able to wake the system from one of these states. You can find ACPI information at *www.teleport.com/~acpi*.

Power management also appears in the required hardware support for the OnNow design initiative, whose goal is to provide specifications for manufacturers to produce hardware that makes a PC appear to be turned off when in reality it is always on and ready for user input. Ideally, a PC would be instantly available without a long boot-up sequence, yet the machine wouldn't use any appreciable power when not in use. You would never have to turn your machine off; it would be ready to receive faxes, dial out for automatic downloads, perform system maintenance, and respond when you touch an input device. When a system designed to PC 98 specs is asleep, it must make no noise (including fan noise) and show no visible sign of power beyond a small status indicator, which must show whether the PC is working, asleep, or asleep according to BIOS settings rather than OnNow settings. Users must be able to adjust the settings easily through software.

The PC's BIOS must also support the OnNow initiative by limiting the number of tests performed by the PC at boot time. The specs recommend a series of possible time-savers, including eliminating, limiting or making optional the tests for floppy disk drives, hard disk types, hard disk controller, system RAM, video RAM, and serial and parallel ports. The BIOS has only 5 seconds to pass the system over to the OS. The BIOS must also contain support for booting from a CD-ROM and for the correct implementation of Year 2000 dates.

> The PC 98 specifications do not eliminate the ISA expansion bus. They do specify that a new PC 98 system may not include ISA expansion devices.

ACPI is concerned with more than just power management. It also assists with Plug and Play (PnP), the hardware-recognition initiative that began with Windows 95 and is more fully supported in Windows 98. The PC 98 specs demand PnP throughout a system's design. ACPI works with the device information in the BIOS to allow PnP to operate more smoothly than before. PnP and power management are also a goal of the Win32 Driver Model (WDM), which lets developers use the same device drivers with only small changes for both Windows 98 and Windows NT 5.0, eliminating many of the driver deficiencies of Windows NT 4.0.

SYSTEM BUSES AND PERIPHERAL DEVICES

Despite what you may have read, the PC 98 specifications do not eliminate the ISA expansion bus. They do, however, specify that a new PC 98 system may not include any ISA expansion devices. The idea is to get rid of the slow ISA protocol entirely, but obviously that isn't going to happen overnight. So even though the system can't ship with any, you can add your old ISA devices to your system. The Entertainment PC 98 specs require that no ISA slots be accessible to end users at all.

All PC 98 systems must include at least one USB port, two for the Entertainment PC. The USB port must be capable of waking your system from its sleep state, so that a USB-connected fax modem, for example, will bring the system back to life when a fax comes in. USB is a hot topic in the PC 98 literature, mainly because devices can be attached and detached without powering down. Pull out the scanner cable and plug in the joystick, and the machine not only won't freeze, it will instantly recognize the device you've attached. It's about time!

One point of particular interest is that under the PC 98 specs the PC is no longer considered a standalone machine. All flavors of PC 98 computers must ship with a communications device—a modem for the consumer and entertainment versions and a network adapter for the office variety. The modem need be only 33.6 Kbps with the 1996 V.34 standard, but its mandatory inclusion should guarantee a horde of new Internet users over the next several months. Installing and configuring modems, after all, has been a huge thorn in the PC user's side and has undoubtedly prevented many people from even trying to access the Internet.

Video cards for a PC 98 system must be designed according to the PCI 2.1 or AGP 1.0 specifications, with AGP required for entertainment machines, at resolutions ranging from 640-by-480 to 1,024-by-768. They must also support multiple-monitor configurations, and the PC 98 specs also recommend support for display on an NTSC- or PAL-based television. All consumer and entertainment PC 98 machines require support for DVD video and MPEG-2 playback, and even notebooks are recommended to provide this support. Entertainment systems must be capable of video capture and analog video input and must come equipped with a TV tuner; those features are recommended on the other PC 98 systems.

ENTERTAINMENT AND WORKSTATION PCs

Because of their emphasis on multimedia and games, entertainment PCs have some special requirements. No ISA expansion is allowed at all—not even ISA slots on the motherboard. All input devices, including everything from keyboards to game controllers, must be designed according to the USB Device Class Definition for Human Interface Devices (USB HID) specifications, so that devices can be easily attached and unplugged without the need to power the machine down. Game controllers in a PC 98 system have to support the use of four devices simultaneously, something that

has been easy with game consoles such as the Nintendo 64, but hopelessly difficult in PCs.

Two USB ports are required, one of which must be easily accessible, which means it must not be on the back panel, and two IEEE 1394 ports, one of which must be easily accessible. The IEEE 1394 standards outline a fast serial bus—up to 400 Mbps—suitable for connecting devices such as removable storage devices and multimedia (audio/video) devices. Multimedia requirements are extensive in the entertainment PC, with required support for both digital (DTV) and analog television (NTSC or PAL) input and output, video input and capture, and MPEG-2 playback. The machine must include a DVD drive with DVD video and an AGP-based 3-D graphics adapter.

The PC 98 specifications don't apply only to Windows 98 machines; a special section of the design guide focuses on systems running Windows NT Workstation 4.0 (and 5.0, when it is available). A Workstation PC 98 requires a higher-end CPU than other PC 98 machines, specifically a Pentium Pro or Pentium II, and at least 64MB of RAM (per processor with multiple CPUs, which the machine is required to support) that can be upgraded up to a gigabyte. Also required is a 512K Level 2 cache (per processor), double the amount for the other PC 98 designs. Hard disks and other storage devices are recommended to be SCSI-based, as are multiple hard disks, so the workstation can be configured for RAID data protection.

THE WRAP

The PC 98 specifications have multiple purposes. First, they force PC manufacturers to design machines that take advantage of the latest hardware and software technologies. For consumers, that means a more capable computer, and for the computer industry, sales of new products. Second, they make PCs more comprehensive and more able to handle new applications. The idea is to move the PC further away from its roots as a text-based tool toward its perceived future as a multimedia-rich business and entertainment device.

Finally, the specs force greater ease of use to go along with increased capability. Gone at last will be the pain of manually configuring peripheral boards, powering down the machine to plug in something as simple as a joystick, and finding out your new software won't run because your computer is missing some fundamental hardware. Why should users have to do any configuring, after all? Let the hardware look after itself.

Neil Randall is the author of The Soul of the Internet *(ITCP) and Special Edition Using* Microsoft FrontPage 98 *(Que).*

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PM

Maintaining Your Windows 98 System

A set of very useful tools in Windows 98 will help you keep your system functioning at its peak.

By Neil Randall

Everyone who owns a car knows the importance of regular maintenance: Without this attention, the thing will let you down at the most inopportune moment. But most of us don't bother maintaining our computers. Sure, we know that hard disks should be checked for errors and defragmented for better performance, directories filled with temporary files should be pruned, and data should be backed up, but that's all very time-consuming and inconvenient.

For those who think that way, and for those who have no idea what computer maintenance entails, Windows 98 offers a set of maintenance tools. The idea behind some of these tools is to keep your system functioning at peak performance, or at least close. Other utilities let you configure your system to ensure that only necessary files load during the boot sequence. Used together, these maintenance tools can make a significant difference in how efficiently and reliably your system will work.

We'll begin by exploring the maintenance tools packed inside Windows 98's Maintenance Wizard, then take a look at the System Configuration Utility. Both are integral to maintaining your system.

MAINTENANCE WIZARD

The Maintenance Wizard doesn't do a great deal by itself. Instead, its function is to help you organize three maintenance procedures: checking the hard disk for errors, deleting unnecessary files, and defragmenting the disk. Each procedure falls under the auspices of a different system utility—ScanDisk, Disk Cleanup, and Disk Defragmenter, respectively—and the Maintenance Wizard lets you set a schedule for running them automatically. You can access and schedule each utility separately. All are available via the System Tools folder in Accessories, as is the wizard itself.

The wizard lets you choose between Express and Custom settings, and we'll assume that if you're reading an article like this, you're probably the sort to choose Custom. The first step is to decide when to schedule the maintenance tools to run automatically. The default is between midnight and 3:00 A.M. local time (make sure your system's time settings are correct), but you can specify days, evenings, or custom settings as well.

One feature of the wizard that doesn't appear in its three main utilities (although the feature is available in the System Configuration utility) is the ability to speed the boot process by preventing programs in the Start-Up folder from loading. The second step in the wizard displays all the executables in the StartUp folder with a check box beside each one. The first time you run the wizard, all the programs are checked. By unchecking a program, you stop it from loading when Windows starts up. This is much easier and more useful than opening the Start-Up folder and deleting program icons (the usual way of preventing automatic starting of programs), especially since the icons remain in the folder and can be reactivated by running the Maintenance Wizard again. If you work with the StartUp folder directly, the only way to reactivate automatic start is to re-create the icon in that folder.

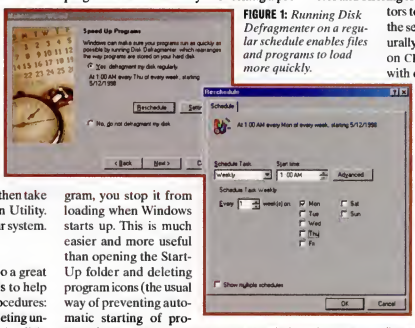


FIGURE 1: *Running Disk Defragmenter on a regular schedule enables files and programs to load more quickly.*

The wizard lets you customize the three system utilities designed for maintenance: Disk Defragmenter (which, as Figure 1 shows, the wizard calls "Speed Up Programs"), ScanDisk ("Scan Hard Disk for Errors"), and Disk Cleanup ("Delete Unnecessary Files"). We'll deal with each of these below. The wizard concludes with a summary of your settings for the three utilities and includes a check box, unchecked by default, to run the utilities when you click *Finish*. The next time you load the Maintenance Wizard manually, you'll be prompted to perform maintenance immediately or to change your settings. In the latter case, the wizard repeats the above sequence.

SCAN HARD DISK FOR ERRORS: SCANDISK

ScanDisk is no stranger to PC users, and Windows 98 follows Windows 95 in providing versions for DOS as well. ScanDisk's purpose is to attempt to detect and fix errors on your hard disk. It can detect problems with the file system—the Windows 98 version of ScanDisk supports drives formatted with FAT32 in addition to FAT16—and it can determine errors in long filenames. It examines the directory structure of the disk for errors, and it checks for problems in the file system structure, looking for cross-linked files and lost clusters, and lets you decide whether or not to repair them. It will also perform an exhaustive analysis of the physical surface of the disk, isolating bad sectors and offering to move data from those sectors to an area of the disk where the sectors are operational. Naturally, ScanDisk cannot be used on CD-ROMs, but it does work with disks that are compressed using DoubleSpace or DriveSpace.

You can schedule ScanDisk, either through the Maintenance Wizard or with the Scheduled Tasks wizard (found in *Start | Programs | Accessories | System Tools*), to run automatically on a periodic basis. If you use Maintenance Wizard to do this scheduling, ScanDisk will run with its most common settings, including automatic fixing of errors (instead of a dialog offering you choices). ScanDisk will also run automatically if you shut down Windows without using the *Shut Down* command in the *Start* menu, a procedure Microsoft introduced with Internet Explorer 4. Unlike the earlier version, Windows 98 starts this ScanDisk operation in automatic repair mode, eliminating the need for interaction if errors are found.

Forcing you to consider establishing an automatic schedule is one of the Maintenance Wizard's primary functions. Ideally, you should run ScanDisk once a week, but in the

real world almost nobody does. In fact, many people never launch ScanDisk, even those who should know better (systems professionals and computer journalists, for example), and as a result are playing fast and loose with possible disk errors. ScanDisk is an important part of Windows 98 maintenance.

SPEED UP PROGRAMS: DISK DEFRAGMENTER

Hard disks hold data in clusters. A cluster can be no larger than 32K, which means many files need more than one cluster for storage. Larger files, such as data files from office and multimedia applications and the files that constitute programs themselves, get stored on multiple clusters of the disk. Ideally, these individual and related files are stored on contiguous clusters, because then the PC has to spend the least possible time locating their components.

Over time, however, as you accumulate more and more files and as current files are increased or deceased in size, individual and related files become spread across noncontiguous clusters. That in itself is not bad for the files—their integrity does not suffer—but loading them into memory takes more time. Portions of an individual file or a collection of related files can be scattered all over the disk, and to load them the computer must locate and read each portion in turn. This takes time.

The purpose of Disk Defragmenter in Windows 98, unlike the aim of Windows 95's version, is to bring related files physically closer together, so that disk seeks take less time and files and programs are loaded more quickly. Windows 95's program worked well at collecting the various portions of individual files into contiguous locations, but Windows 98's Disk Defragmenter goes a big step further by collecting multiple files for entire programs into contiguous locations. When a program launches, the EXE and related DLL files are loaded into memory, but not all at once, and not in sequential order. Disk Defragmenter places a program's files not only on contiguous clusters, but in the order in which the program will need them. In addition, Windows 98 tracks your program usage and uses that information to move your most frequently used programs to the most speedily accessible areas of the disk. The result is that the programs you use most often are also the fastest to load (although differences in size might make one frequently used program load more slowly than others).

To get all this information, Windows 98 monitors the loading of programs through a utility called Task Monitor, which records how each program accesses the disk in a series of log files stored in the Windows\Applog directory. The log file for PowerPoint, for example, would be named PowerPoint.lgx, with *x* denoting the letter of the drive on which the application is stored. There you'll find the names and disk locations of the files PowerPoint reads when loading. You can read the files using Notepad, as you can also read Optlog.txt, another file in the Applog directory, which contains a listing of the programs Disk Defragmenter will attempt to optimize next time it is run.

DELETE UNNECESSARY FILES: DISK CLEANUP

No matter what you do, Windows 98 will always be a disk hog. But you can cut its appetite for disk space to some degree by manually or automatically running Disk Cleanup every so often—weekly, if you're a heavy Internet user. As with the other utilities, the options for Disk Cleanup are more complete in the standalone version than in the Maintenance Wizard, but the idea is the same: automatically deleting a range of files that are not necessary for your system to function. You can launch Disk Cleanup from *Start | Programs | Accessories | System Tools* or by clicking the *Disk Cleanup* button in the *Properties* dialog for the hard disk.

The standalone Disk Cleanup offers three tabs' worth of choices: *Disk Cleanup*, *More Options*, and *Settings*. The Maintenance Wizard offers only the first, but that is the most important of the three. In *Disk Cleanup*, you can select from a variety of files (each with a check box) that you want the utility to delete, either automatically on a periodic basis, or manually whenever you run it. The files include:

- *Temporary setup files.* When you install a program, the installer typically creates setup files in the Windows\Temp directory but doesn't usually clean them out automatically. These files can occupy several megabytes of disk space.
- *Temporary Internet files.* To cut down on the time it takes to load Web documents, Internet Explorer stores copies of previously visited documents and files in a Temp directory. Your disk drive can quickly get clogged with them.
- *Downloaded program files.* In the Windows\Downloaded Program Files folder you'll find Java applets and ActiveX controls that your browser has downloaded from the Web. Even a few Web sessions can produce several megabytes of these files.
- *Recycle Bin.* By default, this option is unchecked, because many people like to keep deleted files in the Recycle Bin so they can restore a deleted file if necessary. But cleaning out the bin once in a while is a useful idea, even if you've set your Recycle Bin to hold only a few megabytes' worth of deleted files.
- *Temporary files.* Many programs create temporary files in the Temp directory (Word does this with automatic saves, for example). Programs delete these files on exit, but in the case of an improper system shutdown or a program failure, the files remain. Disk Cleanup can delete them.
- *Windows 98 uninstallation information.* When you install Windows 98, you are given the option of saving uninstall information in case you want to revert to your previous Windows version. These files occupy 50MB to 100MB of disk space, and you can use Disk Cleanup to get rid of them if you wish. Be aware, however, that you can no longer revert to your earlier version of Windows once you do.

The standalone Disk Cleanup offers additional possibilities. The *More Options* tab gives you access to the Add/Remove Programs utility in Control Panel. You can delete Windows components you don't use (do you really need all those multimedia files and

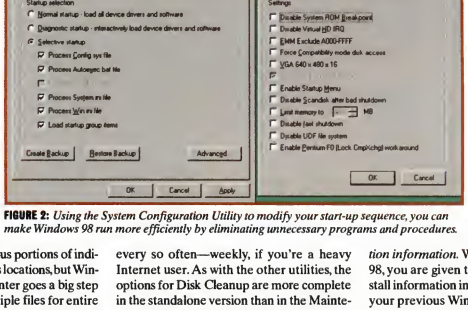


FIGURE 2: *Using the System Configuration Utility to modify your start-up sequence, you can make Windows 98 run more efficiently by eliminating unnecessary programs and procedures.*

desktop themes?) and installed programs that you no longer need. In addition, this tab gives you the option of converting your FAT16 file system to FAT32, which decreases the disk space wasted from partially used clusters. Savings here can be considerable, but bear in mind that partitions formatted with FAT32 are available only to Windows 98 and Windows 95 OSR2. The original Windows 95 cannot access them, nor can Windows NT 4 or DOS, Versions 7 and under. And once you convert a disk from FAT16 to FAT32, you can't change it back to FAT16 without a full reformat (and thus the loss of all data).

The *Settings* tab lets you specify that you want Disk Cleanup to run automatically if you start running out of space on your hard disk. "Running out of space" means different things depending on the size of your disk, but here it means you're down to between 1 and 1.5 percent of the total space. Disk Cleanup will start this way a maximum of once each Windows session (and only if space becomes that limited), and it presents you with a list of delete options.

THE SYSTEM CONFIGURATION UTILITY

Accessed through the *Tools* menu of the System Information utility (*Start | Programs | Accessories | System Tools | System Information*), the System Configuration Utility gives you control over the operating system's start-up procedure. Each of the utility's six tabs lets you control a different element of start-up. You can specify how you want Windows to load, so you can reduce the time taken for start-up by eliminating certain drivers and programs from being loaded into memory. This process is better than editing the actual files, because the elements remain in the files and can be activated by revisiting the utility.

The *Config.sys* and *Autoexec.bat* tabs give you access to these DOS start-up files. Each line in those files is given a check box, and you can uncheck any lines you want to exclude from the boot process. You can also add new lines and edit existing lines through this dialog.

The *System.ini* and *Win.ini* tabs work much the same way, allowing you to uncheck the elements you don't want to load at start-up. Headings, such as `[Fonts]`, have expandable and collapsible menus, so that you can work as deeply inside the INI file as you wish. Again, you can add new lines or edit existing ones.

The *Startup* tab lists all the programs and processes that load with Windows from the registry and the StartUp folder. Included here are such items as LoadPowerProfile (for power management), TaskMonitor (see Disk Defragmenter above), SystemTray, and SchedulingAgent. You can check or uncheck any of these, but you can't add or remove the elements themselves.

The most complex area of the System Configuration Utility is the *General* tab (Figure 2). Essentially, this dialog reproduces the *Startup* menu accessible by pressing the F8 key while Windows is booting. You can specify a normal start-up, with all software and drivers loading—the typical way to boot Windows—or a diagnostic start-up, in which Windows 98 gives you the choice of loading or not loading each program and driver in the start-up sequence. You can also choose *Selective Startup*, checking any number of options. These include processing Config.sys, Autoexec.bat, System.ini, Win.ini, and the items in the StartUp group. By not processing Autoexec.bat, for example, you can determine whether you really need that ancient DOS program in your configuration. If not, select the *Autoexec.bat* dialog and disable it.

The *Advanced* button in the *General* tab gives you access to more start-up procedures. Here you can force the *Startup* menu to appear, and you can stop ScanDisk from running after an improper shutdown. You can force a 640-by-480 display at your next start-up, and you can disable Windows 98's fast shutdown (in which drivers are not unloaded from the system). The purpose of some of these options is to improve system performance, but in most cases the purpose is troubleshooting. In the case of preventing ScanDisk from starting automatically after a bad shutdown, the purpose is the improve boot speed—but at the risk of having improper files on your disk.

For further customization, optimization, and troubleshooting, the *View* menu of the System Configuration Utility gives you access to the Control Panel and Device Manager, the Printers and Fonts folders, and the *Display Settings* and *Multimedia Settings* dialogs.

THE WRAP-UP

From the standpoint of system maintenance, the Maintenance Wizard and the System Configuration Utility differentiate Windows 98 from Windows 95. Third-party software makers have provided similar utilities in the past and will certainly offer more comprehensive variants on these utilities specifically designed for Windows 98; but having them as part of the basic package is obviously useful and probably necessary as the Windows environment gets even more complex. System maintenance is never much fun, but it's necessary, and now we have very few excuses not to perform it. PC

Neil Randall is the author of The Soul of the Internet *(ITCP) and* Special Edition Using Microsoft FrontPage 98 *(Que).*

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Calling Windows APIs from Visual Basic

Changing screen resolution requires calling a Windows API that's not directly supported by VB.

By Matt Hart

Now it's official. Visual Basic has become the most popular programming language around. According to Power Research of Portland, Oregon, developers who list Visual Basic as their primary language number 53 percent of all programmers. And one reason for this is that VB can call almost any API function and thereby make use of almost any feature of Windows.

In this article we'll show you how to make use of Windows APIs even when support for them isn't specifically built into VB. In particular, we'll look at how to use a Windows API function to change display resolution from your VB code. You can download all source code for this project from *PC Magazine*'s Web site, at *www.pcmag.com;* you'll find it in this issue's archive file.

YOU'LL NEED HELP

Starting with VB 4.0, Microsoft decided not to distribute the Windows Software Development Kit (SDK) help file, which is where you find all the explanations, parameters, and declarations for the Windows API. Fortunately, you can find all the information from the SDK online. Microsoft requires you to register for Microsoft Developer Network (MSDN) Online, but the service is free. MSDN Online has the entire SDK available in the form of searchable HTML documents. You can access them at *www.microsoft.com/msdn;* from there click on the *MSDN Library Online* selection.

If you're not willing to wait for online searches, you'll want the actual help file. Although Microsoft allows the API declarations file included with VB to be distributed, users can't distribute the SDK help file included with Visual C++ and other languages! However, I was able to find a copy on the Internet. The 7MB file is on Borland's site at *ftp://ftp.borland.com/pub/delphi/techpubs/delphi2/win32.zip.*

The SDK help file and the corresponding online information refer to many essential constants by name rather than value. In order to find out the values of these constants, you must have the C header files. All the C header files—which include the C function declarations as well as the constants—are contained in the Platform SDK, which you can download from Microsoft at *www.microsoft.com/msdn/sdk/bldenv.htm.* You don't have to fill out any forms for this one; just select which Platform SDK you want.

TIME FOR A CHANGE

With the resources described in the preceding section, you can choose an API function to use in your VB program. Now it's time to look at how to incorporate that function. We'll use a particular display-related function as an example, and we'll touch on a few related functions in passing.

> VB can call almost any API function and thereby make use of almost any feature of Windows.

Sometimes a programmer needs to change the current display resolution. Rather than providing instructions directing users to access the Control Panel's display-settings page, you can change the resolution—and check the system capabilities—directly via code. The magic API call for this is `ChangeDisplaySettings`. Unfortunately, this function is not listed in VB's API declarations file. Here is the C declaration listed in the SDK:

```
LONG ChangeDisplaySettings(LPDEVMODE
lpDevMode, DWORD dwflags);
```

You can also see which DLL this function is contained in by clicking the *QuickInfo* option. The C header file listed is Winuser.h, and the API function is in User32.dll.

If you glance at Winuser.h, you'll see two more function declarations, `ChangeDisplaySettingsA` and `ChangeDisplaySettingsW`. Most API functions have A and W versions. You use the A version when you are passing ANSI strings, which have 1 byte per character. The W version is for Unicode (or *wide*) strings. In general, you'll use the A function to call the procedure from VB. That's because VB converts its internal Unicode strings to ANSI before passing them to external DLL procedures (then converts them again on the way back).

If you don't have the correct C include file to make sure of your declaration, you can use QuickView, a built-in Windows utility, to see the function names inside a particular DLL. Just open an Explorer window and make sure you have your *View* options set to *Show All Files;* don't check the *Hide MS-DOS file extensions*... box. Right-click on the DLL in question—User32.dll in this case—and select *QuickView.* Maximize the newly opened QV window and scroll down to the Export Table section. There you'll find `ChangeDisplaySettingsA` and `ChangeDisplaySettingsW` listed in alphabetical order, along with every other API function in User32.dll.

Having determined that you need to use the `ChangeDisplaySettingsA` procedure, you can begin creating the VB declaration for it.

```
Private Declare Function
ChangeDisplaySettings Lib "user32"
Alias "ChangeDisplaySettingsA"
```

Note that I've maintained the original SDK name rather than directly using the A name, by using the `Alias` keyword to tell VB the name of the procedure contained in the DLL. Also, you need to use the same case as the DLL. If you used `Alias changedisplaysettingsA` instead of `Alias ChangeDisplaySettingsA`, you would receive an error message ("Can't find DLL entry point changedisplaysettingsA in user32") when you tried to use the function.

The first parameter in the API function is

```
LPDEVMODE lpDevMode
```

`LP` indicates that this is a long pointer, and you can see from the SDK that it's a `DEVMODE` structure. When the parameter is a pointer, I usually use `As Any` rather than the actual structure. That way if I need to pass something other than a `DEVMODE` structure, I can do it without a second declaration. Many API procedures accept a `NULL` for some parameters, and they perform some default actions; the `ChangeDisplaySettings` procedure is no exception. If you pass a `NULL` instead of a `DEVMODE` structure, the display returns to its default mode after a

```
Const CCHDEVICENAME = 32
Const CCHFORMNAME = 32

Private Type DEVMODE
  dmDeviceName As String * CCHDEVICENAME
  dmSpecVersion As Integer
  dmDriverVersion As Integer
  dmSize As Integer
  dmDriverExtra As Integer
  dmFields As Long
  dmOrientation As Integer
  dmPaperSize As Integer
  dmPaperLength As Integer
  dmPaperWidth As Integer
  dmScale As Integer
  dmCopies As Integer
  dmDefaultSource As Integer
  dmPrintQuality As Integer
  dmColor As Integer
  dmDuplex As Integer
  dmYResolution As Integer
  dmTTOption As Integer
  dmCollate As Integer
  dmFormName As String * CCHFORMNAME
  dmUnusedPadding As Integer
  dmBitsPerPel As Integer
  dmPelsWidth As Long
  dmPelsHeight As Long
  dmDisplayFlags As Long
  dmDisplayFrequency As Long
End Type
```

FIGURE 1: *The type declaration for a DEVMODE structure.*

temporary mode change. In order to pass a `NULL`, which in VB is `ByVal 0`, you must declare the parameter `As Any` to avoid a syntax error. Thus, the VB parameter is

```
lpDevMode As Any
```

The `DEVMODE` type declaration is in Win32api.txt, which is included with VB. It is shown in Figure 1, in case you don't have the file. (You can get it from *www.webczar.com/defcon/mh/WIN32API.ZIP*.)

The second parameter in the C declaration is

```
DWORD dwFlags
```

Note that there is no `LP` in front of `DWORD`, so the parameter is a double word (long integer) passed by value, not by reference. Thus the VB parameter is

```
ByVal dwFlags As Long
```

The C declaration starts with `LONG`, which means the function returns a long integer. So to complete the VB declaration, you have

```
Private Declare Function
ChangeDisplaySettings Lib "user32"
Alias "ChangeDisplaySettingsA"
(lpDevMode As Any, ByVal dwFlags
As Long) As Long
```

According to the SDK, only a few members of the `DEVMODE` structure need be set in order to switch modes. In practice, however, you need to fill the `DEVMODE` structure with the exact information for the screen mode you need. The SDK provides a function you can use to fill `DEVMODE`.

```
Private Declare Function
EnumDisplaySettings Lib "user32"
Alias "EnumDisplaySettingsA"
(lpszDeviceName As Any, ByVal
iModeNum As Long, lpDevMode As
Any) As Boolean
```

You might notice that in the SDK this function is declared as

```
BOOL EnumDisplaySettings(LPCTSTR
lpszDeviceName, DWORD iModeNum,
LPDEVMODE lpDevMode);
```

`LPCTSTR` indicates that the first parameter is a long pointer to a string. I used `As Any` because you actually need to pass a null pointer here to get the correct device settings. If you pass a blank string, it isn't a `NULL` value, it's a pointer to a blank string. An actual value of 0 needs to be passed.

The `lpszDeviceName` specifies the display device being queried; we will pass a null pointer, which indicates the default display device. To get information about all the possible display settings, you call this function repeatedly—setting `iModeNum` to 0, 1, 2, and so on, and stopping when the function returns 0. For each mode number, the function fills the `DEVMODE` structure pointed to by its third parameter with the values needed to activate that mode. You'll later pass this `DEVMODE` structure to `ChangeDisplaySettings` to switch modes.

Several constant values are needed for these procedures. They are listed in Wingdi.h (which also has the C `DEVMODE` structure) as

```
#define DM_BITSPERPEL
0x00040000L
#define DM_PELSWIDTH
0x00080000L
#define DM_PELSHEIGHT
0x00100000L
```

These translate easily to VB as

```
Const DM_BITSPERPEL = &H40000
Const DM_PELSWIDTH = &H80000
Const DM_PELSHEIGHT = &H100000
```

Another constant needed is

```
Const CDS_UPDATEREGISTRY = &H1
```

This flag tells `ChangeDisplaySettings` to update the Windows registry, which makes the change permanent. The other flags that affect this and allow you to switch temporarily, or to test whether switching is possible, are

```
Const CDS_TEMP = 0
' I made this one up, it's just
  listed as "0"
Const CDS_TEST = &H2
```

The return values for `ChangeDisplaySettings` are

```
Const DISP_CHANGE_SUCCESSFUL = 0
Const DISP_CHANGE_RESTART = 1
Const DISP_CHANGE_FAILED = -1
Const DISP_CHANGE_BADMODE = -2
Const DISP_CHANGE_NOTUPDATED = -3
```

The SDK explains each of these, but the main one you'll test for (after `DISP_CHANGE_SUCCESSFUL`) is `DISP_CHANGE_RESTART`, which indicates that the computer must be restarted in order to switch the mode. `DISP_CHANGE_RESTART` is usually returned if you change the color depth of the screen.

There are some applications that can change color depth without rebooting. But Windows doesn't directly support this, because other running applications expect the existing color depth to remain unchanged

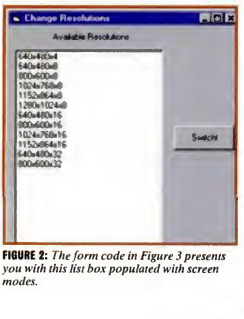


FIGURE 2: *The form code in Figure 3 presents you with this list box populated with screen modes.*

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and can crash if it is changed.

Just switching the resolution from, say, 640-by-480 to 800-by-600 isn't difficult for an application to handle. In fact, Windows handles displaying applications correctly at varying resolutions.

If the system does need to be rebooted to effect a resolution change, the API function `ChangeDisplaySettings` will return `DISP_CHANGE_RESTART`, and you can then call `ExitWindowsEx` with the `EWX_REBOOT` flag:

```
Private Declare Function ExitWindowsEx
Lib "user32" (ByVal uFlags As Long,
ByVal dwReserved As Long) As Long

  Const EWX_REBOOT = 2
```

CHANGING RESOLUTIONS

For our example application, I've added a list box control to a VB form (see Figure 2), plus a button for activating the resolution change.

In the `Form_Load` event, you need to populate the list box with the available resolutions as well as store the `DEVMODE` structures for each of those resolutions. To make those `DEVMODE` structures available after the `Form_Load` event is finished, you need to declare some public variables in the `Declarations` section of the code:

```
Dim D() As DEVMODE,
lNumModes As Long
```

Then you can dimension the `D()` array as needed in the `Form_Load` procedure (see Figure 3). When you run the program, you can see that the list box is populated with screen modes. Since the box isn't sorted, the ListIndex that the user chooses corresponds directly to the element of the array `D()` containing the `DEVMODE` for that resolution. The Click event of the command button changes the resolution and reboots if necessary:

```
Private Sub Command1_Click()
    Dim l As Long, Flags As Long, x
    As Long
    x = List1.ListIndex
    D(x).dmFields = DM_BITSPERPEL Or
    DM_PELSWIDTH Or DM_PELSHEIGHT
    Flags = CDS_UPDATEREGISTRY
    l = ChangeDisplaySettings(D(x),
    Flags)
    Select Case l
        Case DISP_CHANGE_RESTART
            l = MsgBox("This change
            will not take effect
            until you reboot the
            system.  Reboot now?",
            vbYesNo)
            If l = vbYes Then
                Flags = 0
                l = ExitWindowsEx
                (EWX_REBOOT, Flags)
            End If
        Case DISP_CHANGE_SUCCESSFUL
        Case Else
            MsgBox "Error changing
            resolution! Returned: " & l
    End Select
End Sub
```

```
Private Sub Form_Load()
    Dim l As Long, lMaxModes As Long
    Dim lBits As Long, lWidth As Long, lHeight As Long
    lBits = GetDeviceCaps(hdc, BITSPIXEL)
    lWidth = Screen.Width \ Screen.TwipsPerPixelX
    lHeight = Screen.Height \ Screen.TwipsPerPixelY
    lMaxModes = 8
    ReDim D(0 To lMaxModes) As DEVMODE
    lNumModes = 0
    l = EnumDisplaySettings(ByVal 0, lNumModes, D(lNumModes))
    Do While l
        List1.AddItem D(lNumModes).dmPelsWidth & "x" & _
                      D(lNumModes).dmPelsHeight & "x" & _
                      D(lNumModes).dmBitsPerPel
        If lBits = D(lNumModes).dmBitsPerPel And _
           lWidth = D(lNumModes).dmPelsWidth And _
           lHeight = D(lNumModes).dmPelsHeight Then
            List1.ListIndex = List1.NewIndex
        End If
        lNumModes = lNumModes + 1
        If lNumModes > lMaxModes Then
            lMaxModes = lMaxModes + 8
            ReDim Preserve D(0 To lMaxModes) As DEVMODE
        End If
        l = EnumDisplaySettings(ByVal 0, lNumModes, D(lNumModes))
    Loop
    lNumModes = lNumModes - 1
End Sub
```

FIGURE 3: *This VB Form_Load procedure populates a list box control with the available resolutions, with the current one highlighted, and stores the DEVMODE structures for each of those resolutions.*

When you select a resolution and click the button, the `DEVMODE` stored in the `D()` array is passed to the API function `ChangeDisplaySettings`. The `dmFields` element of the `DEVMODE` is used to determine the display settings to be changed. If the `DISP_CHANGE_RESTART` value is returned, then you need to reboot before the changes will take effect.

`ChangeDisplaySettings` is useful for games and also for imaging and drawing programs. If you've created a game that runs well only in a specific resolution, you can use this function to switch to that resolution.

WHERE AM I?

But what if you want to know what resolution you are currently in? VB provides the `Screen` object, which can tell you the width and height of the current screen but not the color depth. For that, you need the API function `GetDeviceCaps`.

```
Private Declare Function
        GetDeviceCaps Lib
        "gdi32" (ByVal hdc As
        Long, ByVal nIndex As
        Long) As Long

  Const BITSPIXEL = 12
```

Just modify the `Form_Load` event slightly (see Figure 3) and you can place the highlight bar directly on the current screen mode.

END OF THE LINE

I hope this article not only has given you a useful new API procedure but also will help you translate other more obscure API procedures and understand how they work. Through MSDN Online, Microsoft has provided a lot of information and samples to help you use the many Windows API functions with Visual Basic. There are also several excellent books on the subject, including Daniel Appleman's *Visual Basic Programmer's Guide to the Windows API* (Ziff-Davis Press, March 1997). If you are intent on exploring the Windows API using Visual Basic, I encourage you to download the Windows SDK help file from the Borland FTP site listed above and to purchase Mr. Appleman's book. PC

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Matt Hart has been programming in BASIC since 1979. He heads the accounting software division of a small ISV in Tulsa, Oklahoma.

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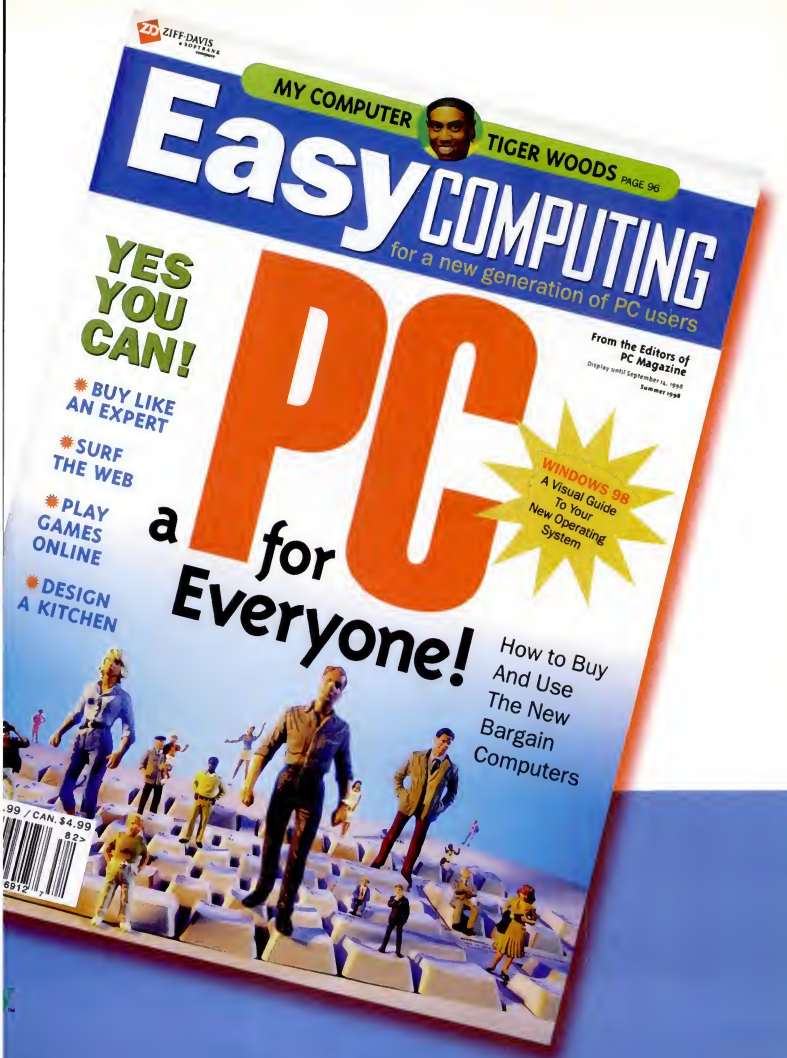
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The Benchmark

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User-to-User

By Neil J. Rubenking

Manage Toolbars in Win 98

To create an extra toolbar in Windows 98 (or Windows 95 with Internet Explorer 4), drag either My Computer, Network Neighborhood, or Recycle Bin to the edge of the screen. The mouse pointer has to touch the border. When you release the mouse, a new toolbar will be created, and you can modify it or move it to another place.

Bernardo Perez
via the Internet



FIGURE 1: *Windows 98's toolbars provide a new way to launch programs.*

PC MAGAZINE: Under Windows 95, you already have a choice of launching programs from the *Start* menu or from shortcut icons on the desktop. Now, with Microsoft's Active Desktop (available in Windows 98, Windows NT 5, and Internet Explorer 4), the desktop can be replaced by a Web page. When the desktop is a Web page, the desktop icons become a distraction, and by default they're not displayed. To make up for the loss of the desktop as a program launching pad, Microsoft introduced user-configurable toolbars.

A system with Active Desktop installed displays a Quick Launch toolbar on the taskbar, just to the right of the *Start* button. From this toolbar you can launch IE4, launch Outlook Express, view Active Channels, and quickly minimize or restore all programs on the desktop. You can enable three other optional toolbars by right-clicking the taskbar, choosing *Properties*, clicking *Toolbars*, and then checking off *Address*, *Links*, or *Desktop*. The Desktop toolbar displays the icons from your desktop, and the Links and Address toolbars duplicate their namesakes within Internet Explorer.

To create a new toolbar via the menu, however, you have to right-click the taskbar, click *Toolbars*, click *New toolbar*, and navigate to an existing directory, preferably one that contains only shortcuts. The drag-to-the-edge method described above is much simpler, and you can use it with any folder, not just My Computer, Network Neighborhood, and Recycle Bin. For example, right-click the *Start* menu, choose *Explore*, open the Programs folder, and open the Accessories folder within it. Now drag the System Tools folder to any edge of the desktop or onto the taskbar, and release the folder. You've created an instant toolbar of system tools.

As Figure 1 shows, if you activate very many toolbars, you'll have to increase the height of your taskbar substantially. You can save some space by carefully setting the properties of your toolbars. Right-click each toolbar's title or left end, choose *View* from the pop-up menu, and make sure *Small* is checked. Remove the check marks next to *Show Text* and *Show Title*. You've now reduced the toolbar to a bare minimum, showing nothing but icons. If you forget what a particular icon represents, rest the mouse over the icon and its title will appear in a ToolTip.

Use Rundll32.exe to Format Disks and More

I have several old batch files that I've used for various tasks, such as formatting a floppy disk and then backing up a group of files to the disk using `XCOPY`. *I've been rewriting these batch files in the WinCmd language, to make them more compatible with Windows. (Remember WinCmd? It was a* PC Magazine *utility circa April 1993.) When I was converting to WinCmd, using the old DOS Format command seemed like a step backward. Then I noticed the little GUI-oriented format applet Windows uses when you right-click a floppy disk drive and choose the* Format *option. After a lot of exploration, I discovered you can launch it with the following command:*

```
rundll32.exe
  "shell32.dll,SHFormatDrive"
```

You can then use WinCmd's sendkeys *command to select the options you want and start the formatting.*

James A. Warrington
West Simsbury, Connecticut

PC MAGAZINE: You can use this technique in just about any scripting language or even in a plain batch file. Even if you're using a full-scale programming language, you may find Rundll32.exe useful, because the `SHFormatDrive` function is not listed in the standard Windows API documentation.

Rundll32.exe is used extensively by Windows 95 and Windows NT 4 to launch a wide variety of actions defined in DLLs. One of its many capabilities is invoking Control Panel applets. A file with the .cpl extension contains one or more applets, and some of the applets may display multiple pages. Using Rundll32.exe, you can launch any of the applets found in a CPL file, and in many cases you can cause the applet to open on a particular page. The basic syntax is

```
rundll32.exe
  shell32.dll,Control_RunDLL
  filename.cpl
```

To select a particular applet within the file, append a comma, an @ sign, and the zero-based number of the applet. For example, to launch the keyboard applet, which is the second applet within Main.cpl, you would use this command:

```
rundll32.exe
  shell32.dll,Control_RunDLL
  main.cpl,@1
```

If the CPL file does not contain an applet matching the number you've passed, nothing will happen. Thus you can identify the applets within a CPL file empirically by repeating this command from a Windows command prompt, ending with @0, @1, @2, and so on.

Some multipage applets are designed so that they can be opened at a particular page. To do so, you must specify the applet number (@0 for a single-applet file). Then append a comma and the page number. The Microsoft Knowledge Base says that the page number, if supported, is 1-based, but a bit of experimenting shows that some are 0-based. This command line launches the Display Properties dialog and opens to the Appearance page (the third page; number two in a zero-based scheme):

```
rundll32.exe
  shell32.dll,Control_RunDLL
  desk.cpl,@0,2
```

It's very simple to experiment with these possibilities at a Windows 95 command prompt. Once you've determined the correct command to invoke the applet you want, you can use that command in a script, batch file, or program.

Ask Our Advisors

HARDWARE

A Good, Swift Boot?

My system came with a SCSI adapter with only an internal connector, for the internal Jaz drive. I then purchased a flatbed scanner that came with its own SCSI adapter, which had only an external connector. Unfortunately, I didn't have any IRQs left for the new card, so I decided to replace the two with a single card that has both internal and external connectors. The one I'm considering has two models; one is bootable, the other is not. I use my IDE hard disk as my boot disk, so I wonder if there is any reason why I should spend the extra $50 to $75 for the bootable SCSI adapter. Is there a good reason that I'm missing? Would the bootability mean that I could turn on the scanner after booting the computer? (Currently the scanner has to be turned on before the computer.)

MIKE VANCE
via the Internet

PC MAGAZINE: The two-for-one swap for the SCSI cards makes good sense, provided you truly don't have a way to free up an IRQ. Chances are good, however, that you don't need the bootability.

If you did have the bootable SCSI adapter, you could create a bootable Jaz disk and use that to boot from in the event that your hard disk suffered a catastrophic failure. On the other hand, many recent systems have BIOS versions that let you boot from SCSI adapters (or CD-ROM drives, for that matter). And even if your computer doesn't have this feature, you can always create a bootable floppy with the drivers required to get the Jaz drive working, which will give you equivalent protection. Saving $50 or more for half an hour's work is a pretty good return on investment for most folks.

Also, the bootability won't solve your scanner problem, but there is a quick fix for Windows 95 users. If you have a SCSI device turned off when you boot your computer, the device will not be found on the SCSI bus even if you turn it on later. There is a way to trick the system into checking the SCSI bus again for late arrivals, however. Go to the System applet in Control Panel and select the *Device Manager* tab. Then choose the *Refresh* button; the system will rescan the SCSI bus, and your scanner should appear as an available device. This beats rebooting, and it can save a lot of time for people who do not use their SCSI scanners frequently.—*Alfred Poor*

OPERATING ENVIRONMENTS

The Case of the Disappearing Toolbar

I'm just about ready to trash Internet Explorer 3 because of a problem with the Mail module. I get no toolbar, no matter what I do. This only happens in Mail, where all I get when View | Toolbar is checked is two parallel lines about 1 mm apart. Because of this, all I see is my Inbox files, and I can't change folders. My Outbox, Deleted and other folders have effectively disappeared. Do you know how I can get the toolbar back?

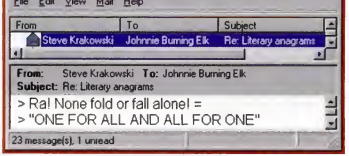


FIGURE 1: *The Mail utility's toolbar has almost disappeared. The only way to get it back is to edit the registry.*

STELIOS PATRIKIOS
via the Internet

PC MAGAZINE: Figure 1 illustrates the problem. I was able to duplicate it by corrupting the Mail utility's stored layout. The toolbar was reduced to a tiny stripe, and nothing I could do would bring it back. The only solution is to carefully edit the Registry. Launch RegEdit and navigate to `HKEY_CURRENT_USER\Software\Microsoft\Internet Mail and News\Mail`. Highlight `Mail`, then select *Export* from the *Registry* menu to make a backup copy of the current settings, just in case. Now highlight the value called `Layout` in the right pane and delete it. The next time you run Internet Mail, the program will use the default layout. From here, you can tweak the settings to get back your own preferred layout. —*Neil J. Rubenking*

WORD PROCESSING

Creating an Acronym List

After creating a document in Microsoft Word 7 with a large number of acronyms, I found out that I needed to add an acronym list. Going through the document word by word seemed both inefficient and error-prone, so I partly automated the process using Word's spell-checker. Here's how:

Start by creating a new custom dictionary called Acronyms. To create it, choose Tools | Options, *then* Spelling | Custom Dictionaries | New. *Enter the name, and choose* Save. *Make sure it's the only custom dictionary with a check next to it and choose* OK, *then* OK *again to return to your document. Next, spell-check the document. Word will stop at most acronyms. In each case, tell it to add the word to the Acronyms dictionary.*

When you're done, use the Tools | Options *command again to reset Word to use your usual custom dictionary. Then move the file Acronym.dic, which you should find in the directory MSOffice\Common Files\Microsoft Shared\Proof, to an appropriate data directory. When you open it, you'll find the acronyms in alphabetical order,*

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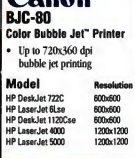
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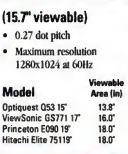
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one to a line, so you can easily add the definition for each.

Alas, this method isn't foolproof. The spell-checker will skip acronyms that also happen to be English words, which means you'll still have to look through the document for acronyms and compare them with the compiled list. Even so, this technique saves a lot of time and effort.

GREG KARAMBELAS
Redondo Beach, California

PC MAGAZINE: Although this innovative use of the spell-checker can certainly help compile an acronym list, a better choice is to take advantage of the pattern-matching capabilities in Word's search-and-replace feature. The best strategy will depend on how you've entered the acronyms, but here's one approach, which assumes that all the acronyms use only uppercase letters.

Starting with a copy of the document—and with the original safely stored under a different filename—you can search for all the words that start with two uppercase characters and format them with any format that you know you haven't used in the document. (For this example, I'll use the strikethrough format.) You can then delete everything that isn't formatted that way, so you're left with acronyms and the occasional odd-ball reference (such as "MSOffice") that isn't an acronym but starts with two uppercase characters.

In Word 7, choose *Edit | Replace*, enter `<[A-Z]{2}>` (including the brackets) in the *Find What* text box, and check the *Use Pattern Matching* check box. In Word 97, the check box is labeled *Use Wildcards*, and you may not be able to see it without choosing the *More* button first. By either name, the check box will tell Word to treat the entry as a pattern to match rather than as a literal match. This particular pattern tells Word to find all words that begin with two uppercase characters from *A* though *Z*. More precisely, the "[A-Z]" tells Word to look for uppercase characters, the "{2}" tells it to look for two in a row, the "<" at the beginning tells it to look for characters at the beginning of each word only, and the ">" at the end tells it to select to the end of the word.

Move to the *Replace With* box. Leave it blank, but while still in the box, choose *Format | Font* and make sure there is a check with a white background—not a gray background—in the *Strikethrough* check box. All other check boxes and text boxes should be blank. Then choose *OK*. Make sure *Search* is set to *All*, and choose *Replace All*. Note that if you simply leave the *Replace With* box blank, Word will delete anything it finds. By defining a format to replace with, however, you're telling Word to keep the text and replace the format.

At this point, all the acronyms will be formatted with the strike-through format. The next step is to search for anything that's formatted in any other way and get rid of it. First, go to the *Find What* box and delete the search entry. While still in the box, choose *Format | Font* and define the font to search for as strike-through. The *Strikethrough* check box should not show a check, while the other check boxes should show a check with a gray background. The text boxes should all be blank. Choose *OK* to return to the *Replace* dialog box. The *Format* designation in the *Find What* area should read *Not Strikethrough*. Go to the *Replace With* text box, and enter `^p`, to replace each match with a paragraph return. Then make sure the *Use Pattern Matching* check box (or the *Use Wildcards* check box for Word 97) is unchecked and choose *Replace All*.

> The check box (labeled *Use Pattern Matching* in Word 7 and *Use Wildcards* in Word 97) will tell Word to treat the entry as a pattern to match rather than as a literal match.

When Word finishes the search-and-replace operation, close the *Replace* dialog box, hit Ctrl-5 (using the 5 key on the numeric keypad) to select the entire file, and choose *Format | Font* to redefine the format and remove the strike-though format from the acronyms. All you should have remaining in the document at this point is a column of acronyms as well as the occasional nonacronym (such as MSOffice) that starts with two or more uppercase letters. Each word will be on its own line. To sort the acronyms (along with the occasional nonacronym), select the entire file with Ctrl-<Numpad 5> once again and choose *Table | Sort Text*. The *Sort Text* dialog box should open, with its options set to sort by paragraphs in ascending order with no header row. Choose *OK* to sort the file.

At this point, you can visually inspect the list, deleting blank lines (which will be together at the beginning of the file) as well as duplicate entries and the occasional nonacronym. You might also use the *Edit | Find* command to search for nonacronyms, by searching for lowercase letters. The search pattern is [a-z].

If you create acronym lists often, you may want to record all these steps in a macro, for a one-step solution. You could also add a routine, or write a separate macro, to search for and delete duplicate entries automatically—an option that I don't have room to show here but that I'll revisit in a future tip if there's enough interest.

For a quick and dirty approach to deleting duplicates and other unwanted lines, you can create a two-column table, add text in the second column for those lines you want to keep, sort by the second column, and then delete all the entries with nothing in the second column.

To create the table, select the entire file with the key combination Ctrl-<Numpad 5>, choose *Table | Insert Table* to create a one-column table, and then—with the entire file still selected—choose *Table | Split Cells* and accept 2 for the number of columns. In Word 97, also make sure that the *Merge Cells Before Split* check box is not checked. Then choose *OK*. Work your way through the list, entering anything you like in the second column—from a single arbitrary character to a definition for the acronym—for each line you want to keep.

When you're finished going through the table, choose *Table | Sort*, which will open the *Sort* dialog box and should automatically select the entire table. Set the *Sort* options to *No Header Row*, sort by *Column 2*, and choose *OK*. This will group the entries that are blank in the second column, so you can select them all and delete them at once. If necessary, sort by the first column again to return the acronyms to alphabetical order.—*M. David Stone*

SPREADSHEETS

Transposing Excel Ranges

When I import text files into Excel, my labels appear down the rows instead of across the columns. Is there a way to rotate the spreadsheet to move the labels from their row positions to column positions?

GILBERT VELA
via the Internet

PC MAGAZINE: You can use Excel's `TRANSPOSE` function for this purpose. `TRANSPOSE` changes the horizontal or vertical orientation of an

array. The syntax is

```
=TRANPOSE(array)
```

TRANSPOSE is an array function, which means you have to use it a little differently from the way you use most of Excel's other functions. The array argument is typically just a range of worksheet cells. But the place where you enter the TRANSPOSE function should also be a range—in this case a range with the same number of columns as array has rows and the same number of rows as array has columns.

Let's say, for example, that you want to transpose A1:D12, a range with 12 rows and 4 columns. You would first select a blank range that had 4 rows and 12 columns—perhaps A14:L17. With that entire range selected, you would type

```
=TRANSPOSE(A1:D12)
```

and then, instead of simply pressing Enter, you would press Ctrl-Shift-Enter. Excel would transpose the cells in A1:D12 and copy them into A14:L17. Each cell in that output range would then contain the formula

```
{=TRANSPOSE(A1:D12)}
```

The braces with which Excel surrounds the formula (you never put these in yourself) simply indicate that the formula is an array. Note that because the entire output range—A14:L17 in our example—is driven by a single formula, you can't edit the formula for any individual cell within the range. You can format individual cells, but if you try to type a number over one of these cells, Excel will produce an error message. To edit the formula, you must start by selecting the entire range.

If you enter the TRANSPOSE formula into a range that doesn't have the appropriate number of rows and columns, Excel will accept the formula, but it will make certain adjustments. If the range is too small, the program transposes only the cells that fit. If the range is too large, it pads the extra cells with #N/A values. If you forget to enter the formula as an array—that is, if you don't press Ctrl-Shift-Enter after typing the formula—you will get a #VALUE! error.

Once you've done the transposition, you may want to get rid of the source cells. To do this, you'll need to convert the array-formula results to a set of constants. Select the output area (the range where you entered your TRANSPOSE formula), copy it to the Clipboard, keep the selection on the output area, and choose *Paste Special* from the *Edit* menu. Once you've converted the formula results to constants, you no longer have an array, and you can modify the contents of cells individually.—*Craig Stinson*

DATABASES

Printing DOS-Style in FoxPro for Windows

After reading your column for several years and using many of your tips, we have finally found a problem we can't solve. We have been running Microsoft FoxPro for MS-DOS 2.5 and are trying to switch to Microsoft FoxPro for Windows 2.6. In the DOS version of FoxPro, you can specify the printer font by sending a character string filled with control codes to the printer, such as:

```
PRSPEC = CHR(27)+"(8U"+CHR(27)
  +"(s0p12.00h10.0v1s0b3T"
SET PRINT ON
SET CONSOLE OFF
? PRSPEC
```

In this case, the printed text would appear in italics until another set of control codes was sent to the printer. FoxPro for Windows 2.6 (FPW26), however, doesn't recognize this as a printer command and simply prints the string as text.

FoxPro for Windows has a FONT *clause for many commands, but a clause is effective for one command only, after which the font reverts back to something else. We are looking for a way either to make FPW26 work like the DOS version or to set a default printer font and use the* FONT *clause for those special occasions when a different font is needed. Otherwise, every print command will have to include the* FONT *command, and we have many such commands in our programs.*

Perhaps this is a problem others are having also. Thanks for your help.

PAUL BRINK
Anchorage, Kentucky

PC MAGAZINE: I'll offer a few solutions that you should consider as temporary fixes until you can fully convert your application to FoxPro for Windows. Your goal should be to migrate to a position where you can support Windows-style printing techniques, which in FoxPro's case means using the Report Writer instead of one of the various direct-printing methods you may be accustomed to using under DOS.

In the meantime, you can set the default printer font using the following undocumented command

```
SET PRINT FONT "fontname",point size
```

For example, to set the default printer font to 8-point Courier New, you would issue the command

```
SET PRINT FONT "Courier New", 8
```

After this command is used, everything should print in that font unless you specify otherwise using the FONT clause.

Microsoft offers several other suggestions for trying to print directly to the printer using FoxPro for Windows. For instance, you can try using ??? " " (three question marks, a space, double quotes, a space, and double quotes) to open the printer in raw mode. Alternatively, you could write both the printer control codes and the contents of your report to a text file and then copy that file to the LPT1.DOS printer port. A third option would be to use the Generic Text Windows printer driver. I've had varying levels of success with these techniques, but they're there for the asking should you decide that SET PRINT FONT doesn't meet your needs.

See the following Microsoft Product Support articles on the *support.microsoft.com/support* Web site for more information: Q99542, "Printing Reports Created w/Question Marks in FP for Win," and Q99595, "Using @...SAY Commands & Control Codes to Print in FP/W." For more information on the LPT1.DOS printer port, see Q68652, "Printing to Windows LPT1.OS2 or LPT1 .DOS Port," and Q82749, "Using LPT1.OS2, LPT1.DOS, or FILE: Ports When Printing."
—*Sal Ricciardi*

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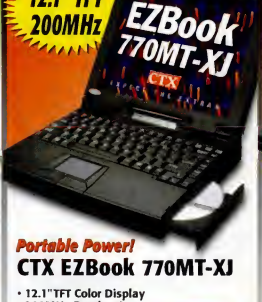
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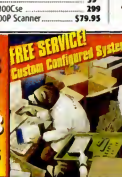
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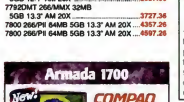
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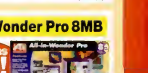
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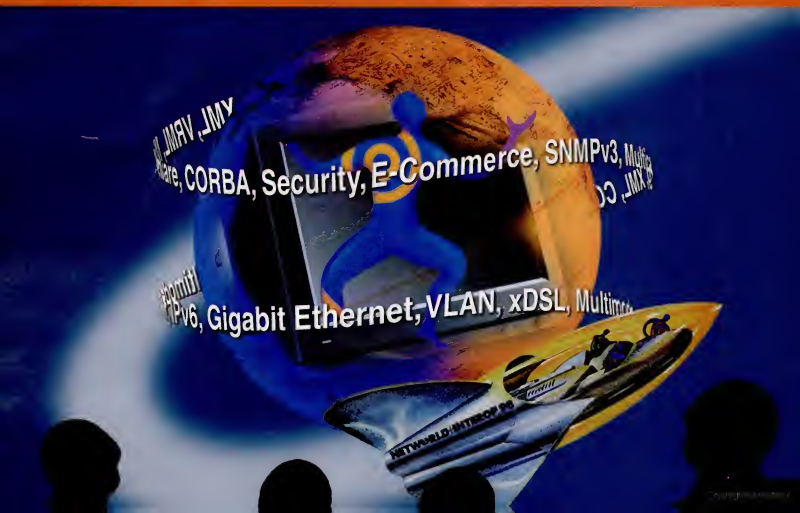
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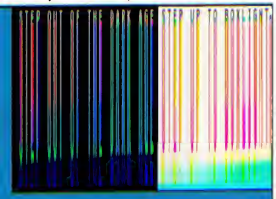
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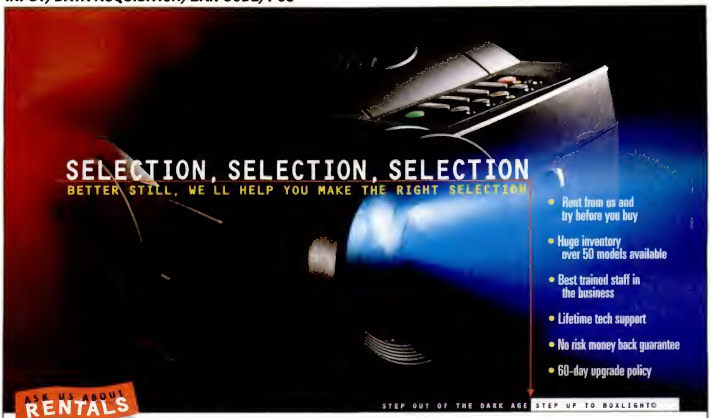
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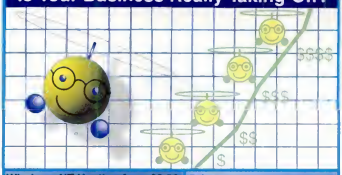
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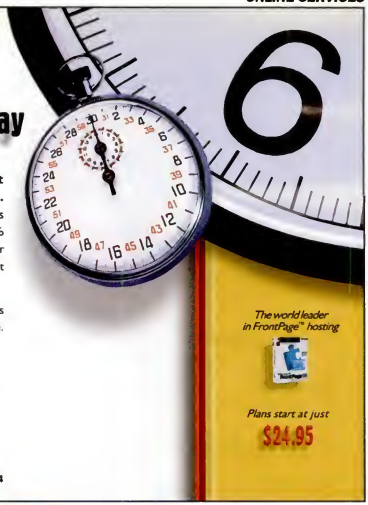
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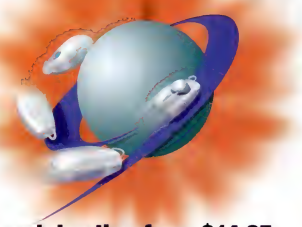
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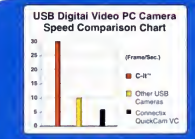
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After Hours

That Voodoo2 That You Do

PC Labs tests the gaming power of nine 3-D accelerators.

By Michael E. Ryan

The original Voodoo 3-D graphics chip set from 3Dfx was so powerful that many game developers created special versions of their games to take advantage of the Voodoo's capabilities. As a result, 3-D accelerators based on Voodoo cards quickly became favorites of hardcore gaming enthusiasts. With the release of the second-generation Voodoo2 chip set, 3Dfx hopes to maintain its loyal following while outslugging the other chip set manufacturers with raw rendering horsepower.

Before considering the purchase of a 3-D accelerator, you should know that this type of card truly shines on a Pentium II–based machine, and you won't notice as much performance enhancement on a Pentium system—even one with MMX. Also, because such cards render in 3-D only, you'll need a separate card for 2-D applications.

PC Labs recently tested nine Voodoo2 3-D graphics cards: the Canopus Pure3D II and Pure3D II LX, the Creative Labs 3D Blaster Voodoo2, the Diamond Multimedia Monster 3D II, the Guillemot Maxi Gamer 3D^2, the Orchid Technologies Righteous 3D II, and three cards from Quantum 3D's Obsidian2 product line: the Quantum 3D S-12 PCI, S-12 AGP, and X-24. Three other Voodoo2 cards—the Hercules Stingray/2, the Metabyte Wicked3D, and the STB Black Magic 3D—were not available in time for testing.

With the exception of the Obsidian2 S-12 AGP, all tested cards are PCI cards, and most come with 12MB of total on-board memory (4MB of frame-buffer memory and 8MB of texture memory). The exceptions were the 8MB Maxi Gamer 3D^2 and the 24MB Obsidian2 X-24. Not surprisingly, the 12MB PCI cards all posted similar performance test results. In fact, we think any of the cards is a solid choice for upgrading your PC's 3-D gaming capabilities. When we factored in pricing, bundled software, and the quality of each card's driver control panel, however, we found the Canopus Pure3D II LX and the Diamond Monster 3D II the best cards overall.



EA Sports' World Cup 98 provides a great example of what a Voodoo2 card can do for games. Note the sharper image quality and the improved level of detail in the 3Dfx version of the game.



Canopus Pure3D II
★★★★½ $329 list. Canopus Corp., 408-954-4500, www.canopus.com.

Canopus Pure3D II LX
★★★★★ $279 list. Canopus Corp., 408-954-4500, www.canopus.com.

The Pure3D II is the only card in the group that has a low-profile, on-board cooling fan. The fan doesn't make much of a performance difference, though: The Pure3D II and the Pure3D II LX (which does not have a fan) turned in identical scores. Still, the fan may help keep the card running smoothly in some PC cases.

Though the performance test results were all quite close, the Pure3D II cards turned in consistently impressive numbers. The cards were second only to the Diamond Monster 3D II on the ZD 3D WinMark 98 tests; the cards trailed the Monster 3D II and the Quantum 3D cards (and the Pure3D II LX trailed the Orchid card) on our Quake II test.

Both Pure3D II cards offer excellent driver control panels that let you adjust a number of performance settings and options, including the memory clock speeds of the cards. The setting ranges from 90 to 100 MHz, and it had no visible effect on our performance tests except that we ran into problems when we set the speed to its maximum 100-MHz setting. In fact, this setting caused our test system to lock up repeatedly. When we set the clock speed to 95 MHz, the system ran smoothly. This occurred with both of

Canopus Pure3D II, II LX

PC MAGAZINE EDITORS' CHOICE

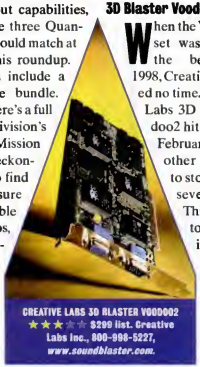
The first Pure3D card, based on the original Voodoo chip set, earned Canopus a solid reputation among game players. The card was a touch faster than most of its competitors, and with it Canopus became something like the BMW of the 3Dfx world. With the Pure3D II cards, Canopus looks to be in a good position to maintain if not strengthen its reputation.

the Pure3D II cards.

During installation, the Pure3D II software adds a program launch bar to your Windows desktop. You can customize the bar to run your favorite games and applications at the touch of a button and also customize your display settings for each button on the bar (including brightness, contrast, and refresh rate). Finally, the Pure3D II includes TV-out capabilities, which only the three Quantum 3D cards could match at the time of this roundup.

Both cards include a hefty software bundle. For starters, there's a full version of Activision's Quake II Mission Pack: The Reckoning. You'll also find a virtual treasure trove of playable game demos, including Falcon 4.0, Forsaken, Myth: The Fallen Lords, NHL 98, Quake II, Spec Ops, Tomb Raider II, and Wing Commander: Prophecy.

We were impressed by both Canopus Voodoo2 cards and were especially struck by the Pure3D II LX, which offers excellent performance, good drivers, a great software bundle, and (lest we forget) one of the lowest prices in the roundup.



CREATIVE LABS 3D BLASTER VOODOO2
★★★☆☆ $299 list. Creative Labs Inc., 800-998-5227, www.soundblaster.com.

Creative Labs 3D Blaster Voodoo2

When the Voodoo2 chip set was released at the beginning of 1998, Creative Labs wasted no time. The Creative Labs 3D Blaster Voodoo2 hit the streets in February, beating the other accelerators to store shelves by several weeks. This turned out to be a marketing coup. Now that there are so many cards on the market, though, we're not sure the Creative Labs card can continue to thrive.

As far as performance numbers go, the 3D Blaster finished near the bottom of the pack on each of our tests. In fact, the 12MB card bested only one card in this roundup: the 8MB Guillemot Maxi Gamer 3D2. The 3D Blaster's consistently low scores may stem from the relative immaturity of Creative Lab's drivers.

The drivers for the 3D Blaster are, in fact, the same as the reference drivers provided by 3Dfx. As a result, the driver control panel is fairly generic—a far cry from the polished interface employed by Canopus's and Quantum 3D's drivers. Users who like to tinker with such things should note that the 3D Blaster offers no option to adjust the memory clock speed.

Another thing the 3D Blaster lacks is a software bundle. The card we received came without any games or game demos whatsoever (interestingly, the 8MB version of the accelerator comes with three games). Although this may not matter to a hard-core game player with a fully stocked gaming library, it could put off those who are just starting to get into 3-D gaming.



DIAMOND MONSTER 3D II
★★★★★ $299 list. Diamond Multimedia, 408-325-7000, www.diamondmm.com.

The 3D Blaster is a solid if unspectacular Voodoo2 card. It was an ideal card for early users but has since been surpassed.

Diamond Monster 3D II

PC MAGAZINE EDITORS' CHOICE

The Diamond Monster 3D is perhaps the most popular of all the original Voodoo 3-D cards. So when the Diamond Monster 3D II was announced, legions of loyal

PERFORMANCE TESTS

Voodoo2 3-D Accelerators

PC MAGAZINE LABS

We installed each Voodoo2-based 3-D accelerator in an NEC Direction SPL 300, a 300-MHz Pentium II–based machine with an Ultra ATA hard disk and 128MB of RAM. As expected, scores on our ZD 3D WinMark 98 tests were very tightly grouped. In fact, there were only 33 points between the lowest and the highest scores on our tests run at 640-by-480 resolution. Also, all of the Voodoo2 cards with at least 12MB of on-board memory achieved higher scores than the RIVA 128ZX–based Diamond Viper V330 AGP, a 2-D/3-D card we tested for comparison.

The Voodoo2 advantage became even clearer on the Quake II timedemo test. We ran this OpenGL test with each Voodoo2 card's "wait for vertical sync" option disabled (so the cards' scores would not be limited by the monitor's refresh rate). We used Version 3.15 of Quake II, the Map1.dm2 demo file, and the following game options: full screen, no 8-bit textures, CD music disabled, sound quality low, and the sound system set for maximum performance (every other option was at its default setting). The Quantum 3D Obsidian2 cards took the top honors here, though they were closely followed by the Diamond card, the Canopus cards, and the rest of the pack. The vast difference between the Voodoo2 scores and those of the Viper V330 AGP offers solid proof of the Voodoo2 chip set's 3-D gaming capabilities.—*Analysis written by Michael E. Ryan.*

High scores are best. Bold type denotes first place. PC denotes Editors' Choice.	ZD 3D WinMark 98 (640 x 480) Score	(800 x 600) Score	Quake II timedemo (640 x 480) Frames per second
PC Canopus Pure3D II	669	640	68.3
PC Canopus Pure3D II LX	669	640	67.9
Creative Labs 3D Blaster Voodoo2	661	629	67.8
PC Diamond Monster 3D II	**671**	**643**	68.5
Guillemot Maxi Gamer 3D2	638	605	66.3
Orchid Righteous 3D II	661	632	68.2
Quantum 3D Obsidian2 S-12 AGP	661	634	69.5
Quantum 3D Obsidian2 S-12 PCI	663	634	68.7
Quantum 3D Obsidian2 X-24	N/A	N/A	**69.8**
Diamond Viper V330 AGP*	648	597	38.9

* Reported for comparison N/A—Not applicable The card did not complete this test

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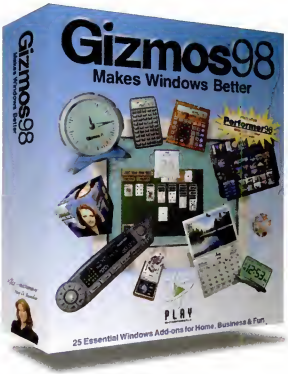
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users took notice. With stellar performance, stable drivers, and an impressive software bundle, the newest Monster surely won't scare off any gamers.

The Monster 3D II is quite simply a solid card. It achieved the highest scores on both the 640-by-480 and 800-by-600 3D WinMark tests and trailed only the Quantum 3D cards on the Quake II test.

Though the Monster 3D II's driver control panel is similar to the one used by the Creative Labs 3D Blaster Voodoo2, the underlying drivers are somewhat more finely tuned (as evidenced by the card's high performance test scores). An easy-to-use slide scale lets you adjust the monitor refresh rate, gamma correction, and more advanced properties such as the use of Direct3D and Glide. Also, the Monster 3D II lets you adjust the memory clock speed. Unlike what you find on the Canopus cards, this setting ranges from 90 to 95 MHz. And Diamond regularly updates its drivers, so users can expect improvements in the driver control panel—and possibly the card's performance—with future updates.

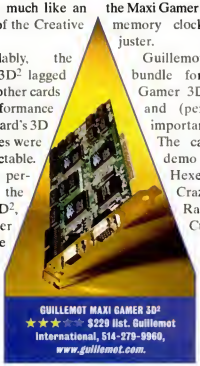
The software bundle is one of the best in the bunch and includes full versions of three games—Battlezone, Incoming, and Monster Truck Madness 2—along with demo versions of several Electronic Arts titles, including Madden NFL '98, Need for Speed II SE, and Wing Commander: Prophecy.

When you combine the card's outstanding features, you have one of the best Voodoo2 boards available. The Canopus Pure3D II LX is $20 cheaper, but the Monster 3D II's strong retail presence and three complete games may sway first-time 3-D buyers in Diamond's direction.

Guillemot Maxi Gamer 3D²

Canadian graphics vendor Guillemot joins the Voodoo2 fray with the 8MB Guillemot Maxi Gamer 3D². Although the company had a 12MB card in development, it was not yet available at the time of this roundup. Based on our tests, the Maxi Gamer 3D² is much like an 8MB version of the Creative Labs card.

Understandably, the Maxi Gamer 3D² lagged behind all the other cards on our performance tests. Still, the card's 3D WinMark scores were pretty respectable. The Quake II performance of the Maxi Gamer 3D², though lower than all the other Voodoo2 cards, still bested the RIVA 128ZX–based Diamond Viper V330 AGP (the top-notch 2-D/3-D card we used for comparison on our performance testing) by nearly 30 frames per second.



The Maxi Gamer 3D²'s driver control panel is nearly identical to the one used by the Creative Labs 3D Blaster Voodoo2 (which, as mentioned earlier, is an unaltered version of the 3Dfx reference drivers). Like the 3D Blaster, the Maxi Gamer 3D² offers no memory clock–speed adjuster.

Guillemot's software bundle for the Maxi Gamer 3D² is decent and (perhaps more important) different. The card includes demo versions of Hexen II, Plane Crazy, Redline Racer, and Sub Culture.

The 12MB Maxi Gamer 3D² should be available by the time you read this. Considering the announced price ($259 list), we think it might make a good choice for budget-conscious gamers. The relative anonymity of the brand is likely to favor its competitors, though, even if their cards cost upwards of $20 more.

Two Cards Are Better Than One

One of the unique features of Voodoo2-based 3-D accelerator cards is their ability to work in tandem with a second Voodoo2 card, in order to split the 3-D rendering chores. This is a configuration known as *Scan-Line Interleave (SLI) mode*. When used in SLI mode, two Voodoo2 cards render alternating scan lines on the screen: One card handles the even-numbered lines, and the other card handles the odd-numbered lines.

You might think this setup would double your performance, but it doesn't. The real benefit is that SLI mode lets you run games at higher resolutions without any significant degradation in performance. For example, a single Canopus Pure3D II card can run Quake II on our test system at about 68 frames per second in 640-by-480 resolution. At 800-by-600, the same card scores around 57 frames per second, and it is not even capable of running the game at 1,024-by-768. In SLI mode, two Pure3D II cards—the cards must be identical to work in SLI mode—can run the game at over 65 frames per second in 640-by-480, 800-by-600, and 1,024-by-768 resolutions.

As mentioned earlier, Voodoo2 is optimized for a Pentium II–based computer. This fact becomes glaringly obvious when you're using two Voodoo2 cards. In fact, it's not surprising to clock slower frame rates when using two cards in an MMX machine than when you've installed just one card. Pump up the CPU to, say, a 333-MHz PII and you'll see results. The focus of the SLI configuration is definitely games played at high resolution on a screaming-fast computer.

Since these are 3-D–only cards, you have to install them along with a basic 2-D or 2-D/3-D graphics card in order to use them. In other words, you need to free up three slots for graphics cards: one for your 2-D or 2-D/3-D card and two for the Voodoo2 cards. You also will have to swallow the added expense of a second $250-plus Voodoo2 card. Then again, you might be surprised by what some people will do just to be able to run Quake II at 60 frames per second in 1,024-by-768 resolution.—*MER*

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The Changing Face of 3-D

The 3-D graphics hardware industry moves very quickly. By the time you read this, the 3Dfx Voodoo2 chip set will be facing fresh competition: The market will soon be flooded with a whole new generation of graphics accelerators, which we'll be reviewing in a future issue. Here's a quick look at the major 3-D chip sets you'll see by the end of 1998.

Matrox MGA-G200. The Canada-based Matrox has a pretty impressive 2-D/3-D chip set of its own. The MGA-G200 promises to deliver what could be the best all-around graphics solution we've seen yet. The chip set supports a host of 3-D rendering features and should make Matrox very competitive indeed in the 3-D accelerator market.

Power VR Second-Generation. From NEC Electronics and VideoLogic, this 3-D–only chip set made a huge splash at the 1998 Electronic Entertainment Expo. It does not yet have the widespread hardware support that the RIVA TNT and Banshee have, but it is a fast, powerful chip set with a broad feature set and good support from game developers. Expect to start seeing Power VR Second-Generation products during the fall of this year.

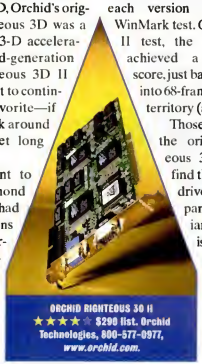
Riva TNT. From nVidia, this impressive new 2-D/3-D chip set follows the hugely successful RIVA 128 and RIVA 128ZX chip sets and should be available by the time this magazine reaches your hands. This is a very powerful chip set that promises to deliver Voodoo2-level performance in a single-card solution. The RIVA TNT is clearly one of the early favorites to capture the 3-D gaming crown, as numerous hardware and software vendors (including Activision and STB Systems) have already lined up behind it.

S3 Savage3D. S3 hasn't exactly dazzled the gaming world with its 3-D chip sets in the past, but the Savage3D may change all that. With a feature list that can compete with any of the other chip sets and hardware support from companies like Hercules, the 2-D/3-D Savage3D is this year's dark-horse contender for the 3-D crown. This also figures to be one of the least expensive of the new chip sets—and the first to reach store shelves.

Voodoo Banshee. Not to be outdone, 3Dfx is already hard at work on the next generation of Voodoo chip sets. The Voodoo Banshee promises not only to incorporate 2-D graphics capabilities but to do so at unprecedented performance levels. On the 3-D side, we're sure that the Voodoo Banshee will push the envelope once again. But when it does, it will maintain full compatibility with all previous Voodoo- and Voodoo2-compatible software. Diamond Multimedia has already announced its intention to support the Voodoo Banshee.—*MER*

Orchid Righteous 3D II

Like the original Diamond Monster 3D, Orchid's original Righteous 3D was a very popular 3-D accelerator. The second-generation Orchid Righteous 3D II seems good bet to continue as a fan favorite—if it's able to stick around on the market long enough.



As we went to press, Diamond Multimedia had announced plans to acquire Orchid Technologies. This acquisition has not been finalized, however, and the future of the Righteous 3D II has not yet been decided.

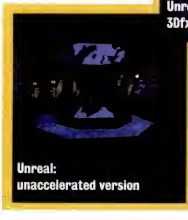
The Righteous 3D II performance scores were in line with those of the Creative Labs 3D Blaster Voodoo2 on each version of our 3D WinMark test. On the Quake II test, the Orchid card achieved a respectable score, just barely breaking into 68-frame-per-second territory (at 68.2).

Those who used the original Righteous 3D card will find the new card's driver control panel very familiar. Although it is somewhat crowded and less intuitive than the Canopus and Quantum 3D applets, it offers a wealth of features and options for fine-tuning its performance (including the memory clock-speed adjuster). Of note on the driver control panel is the button that links you to Orchid's online manual and technical-support numbers.

The Righteous 3D II's software bundle is satisfying, although not overwhelming. It includes demo versions of Battlezone, G-Police, Incoming, and Jedi Knight: Dark Forces II.

Our overall impression of the Righteous 3D II was that it's a solid, reliable accelerator card, which will most likely be popular among existing Orchid customers. In a head-to-head comparison, however, the Canopus Pure3D II LX and the Diamond Monster 3D II come out on top.


Unreal: 3Dfx version


Unreal: unaccelerated version

In GT Interactive's Unreal, Voodoo2 acceleration provides not only better performance and image quality but a number of special visual effects as well. Note the reflective surface on the floor and the smooth transparency of the force field.

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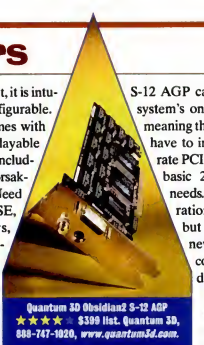
After Hours

Quantum 3D Obsidian2 S-12 AGP, S-12 PCI, X-24

To return to a previous analogy: If Canopus is the BMW of the 3Dfx world, Quantum 3D is clearly the Ferrari. The Quantum 3D Obsidian 100SB-4440, which incorporated the components of two full Voodoo graphics cards on a single, full-length PCI card, blew the doors off every other 3-D card on the market—and cost as much as $1,700 when it debuted. Now Quantum 3D is jumping into the Voodoo2 pool with both feet, delivering four different cards based on the new chip set.

We looked at three of the cards, each one a member of the Obsidian2 product line: the S-12 AGP, the S-12 PCI, and the X-24. Their performance numbers were impressive in some ways and disappointing in others. Though the Canopus and Diamond cards claimed the top spots on our 3D WinMark tests, the S-12 AGP and S-12 PCI both performed well. The X-24, a 24MB Voodoo2 card, failed to complete the 3D WinMark tests: Each time we them, the system locked up. During the Quake II test, though, the X-24 flexed its muscle and turned in a fine 69.8 frames per second. The S-12 AGP and S-12 PCI also did well on the Quake II test (scoring 69.5 and 68.7, respectively). When we ran the Quake II test at a higher resolution (800-by-600), the X-24 maintained 69 frames per second; all the other cards dropped off considerably, registering scores in the mid-50s. (These results are not reported on our performance test chart.)

The Quantum 3D driver control panel (used by each card) is well designed. Like the Canopus applet, it is intuitive and configurable. Each card comes with loads of playable game demos, including Barrage, Forsaken, Incoming, Need for Speed II SE, Shipwreckers, Wing Commander: Prophecy, and World Cup 98. Also, all the cards include TV-out capabilities.



Unfortunately, the X-24's instability makes us hesitant to recommend it. Quantum has recognized the problem and issued replacement cards, but we were unable to get one in time for testing. Also, the S-12 AGP card ties up a system's only AGP slot, meaning that you would have to install a separate PCI card for your basic 2-D graphics needs. This configuration works well, but since most new systems come with a decent 2-D AGP graphics card, we're not convinced the S-12 AGP will have much of an audience. Finally, the S-12 PCI, which turned in respectable performance scores, faces stiff competition from the lower-priced Canopus Pure3D II LX and the Diamond Monster 3D II.

Coming Up

What's in the Next Issue of *PC Magazine*

Year 2000—What to Do

PCs could have BIOS problems, but some software programs could have much bigger problems. (Have you checked your macros?) Even though time is running short, you *can* still tackle potential year-2000 issues. How do you plan and carry out remediation if you've got problems? You'll need to prioritize and tackle the most mission-critical systems first. In our next issue, *PC Magazine* lays out the territory and gives you guidelines for getting control of your year-2000 problem.

XML

This is not an entirely new technology but an evolutionary step from SGML, said to enable easier application interoperability. We'll explain what XML is and why you should care about it. Also, we'll demonstrate XML's significance in several discussions of products that have already adopted it.

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Abort, Retry, Fail?

more of WHAT'S HOT TODAY

- HOMICIDE: Enter the cyberworld of Role Playing Games!
- SATURDAY NIGHT LIVE in Streaming Video: Screening Room!

Eerie coincidence. These promos appeared on NBC's Web site on May 28, the same day that star Phil Hartman was murdered.

Britannia Rules the Waves

Why not provide high-speed Internet access through power lines? Well, as Reuters reported, "Trials of the systems in the central English city of Manchester showed it was fast, but surfers of the Internet discovered that the data they were downloading was being broadcast as high-frequency radio waves through the streetlamps." Not only that, but it "interfered with the BBC World Service." Blimey!

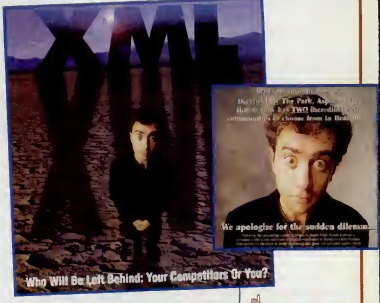
Oh, Oh, Oh, I'm on Fire

From the newsletter of the American Consulting Engineers Council, this important advice on how to write effective e-mail messages, with which we couldn't agree more: "Do not send highly emotional or flammable messages via e-mail."

Yes, simple methods of destruction are best. (*Java Developer's Journal.*)

Castanet

Castanet is for businesses that wish to lower the cost and simplify the complexity of destroying, managing and updating applications and information over corporate networks and the Internet. *Castanet* channels





"We're not sure what it is. Rob cobbled it together from paper clips and stuff in the mail room, but MAN wait till you see how scalable it is."

Sounds Painful!

So there we were, shopping for motherboards at ASUStek Computers' Web site, when we came across a description of this interesting model: "The KN97-X is designed to provide maximum power by crunking out every juice of the Intel Pentium II CPUs." We'll wait to see PC Labs' JuiceCrunk test results before making any decision.

So is he shopping for a house or learning how to write XML code? We can't tell. (webMethods ad and Aspen Ridge Homes ad.)

If your entry is used, we'll send you $50 and a *PC Magazine* T-shirt. Send your entries to Abort, Retry, Fail?, *PC Magazine*, One Park Ave., New York, NY 10016-5802 or via e-mail (text items only) to *don_willmott@zd.com*. Winners this issue: Shawn P. Dikes, John Mahoney, Raja Rajagopalan, and Bob Yanka.

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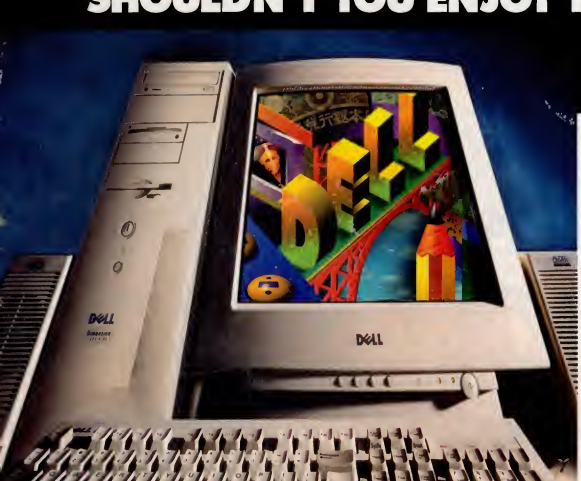
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